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THIS JOURNAL IS DEVOTED TO THE SCIENCE AND TECHNOLOGY OF PAINT APPLICATION, ELECTRODEPOSITION, VITREOUS ENAMELLING, GALVANIZING, ANODIZING, METAL SPRAYING & ALL METAL FINISHING PROCESSES. THE EDITOR IS PREPARED TO CONSIDER FOR PUBLICATION ANY ARTICLE COMING WITHIN THE PURVIEW OF "METAL FINISHING JOURNAL" AND ALL SUCH ARTICLES ACCEPTED WILL BE PAID FOR AT THE USUAL RATES.

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ROLL OUT THE BARREL

FROM a study of reports and information emanating from the U.S.A., it is becoming increasingly apparent that considerable use is being made of various barrel finishing techniques in the mass finishing of a very wide range of components and articles. We have commented on previous occasions on this page on the seeming reluctance of British industry to take advantage of the marked advances that have been made in barrelling equipment and techniques. (It might perhaps be wise to observe here that the process referred to is the mechanical surface finishing of objects by enclosing them in a rotating barrel with a quantity of abrasive material and other media. No reference to barrel plating is intended as this process is the subject of a totally different set of design and application criteria.)

At first sight the subjection of a metal surface to the action of a mass of abrasive pebbles under the conditions obtaining in a large horizontally mounted rotating octagonal barrel, does not appear to be a process which can be brought under any sort of delicate control, and it might be expected that objects so treated would emerge from the barrel as battered hulks. Surprisingly enough however, such is not the case, and even in the early days of the process when it was used almost entirely for simple deburring operations it showed very little tendency to distort even light gauge articles.

Since those days a considerable amount of research and development effort has been expended on the process so that it has now achieved, in its most reputable manifestations, a degree of flexibility and susceptibility to control, which render it well worthy of consideration by anyone faced with the need to produce a smooth, semi-bright surface on a metal article.

Barrel finishing can, in the broadest sense, be considered as a member of that family of finishing processes characterized by the subjection of the component being finished to the action of mechanically propelled, but otherwise unrestrained abrasive, and including such kindred members as shot and grit blasting and abrasive sludge blasting.

Among the properties shared by this class of process is adaptability to mass-production requirements, and indeed, the possibility of semi-automation. Furthermore, by the development of new types of steel shot, grits of widely differing hardness, and tumbling media with tailor-made properties, the range of application of these processes has been greatly broadened in recent years.

Nor does it appear that only minor advances in equipment and techniques are possible as what may well prove to be a revolutionarily new approach was announced recently by a large American corporation. By rotating vertically mounted barrels containing abrasive at very much higher speeds than are customary in the process and by rigidly attaching the components to be processed to a contra-rotating spindle, processing times have been reduced very nearly to as many minutes as hours were required previously. There is no doubt that the potentialities of the abrasive finishing processes are still worthy of further study and that they are capable of yielding more contributions to the mechanization of metal finishing.

Talking Points

by "PLATELAYER"

TOPICAL COMMENT FROM THE MAIN LINES AND SIDE LINES OF METAL FINISHING

VACUUM FILLS THE PORES

THE applications of vacuum in industry are constantly extending now the notoriously difficult problem of plating die-castings satisfactorily and consistently may soon be greatly reduced by the advent of the new process of vacuum die-casting. In this method vacuum is applied to the dies, with the result that much more homogenous and non-prous castings are obtained. The troubles that arise in plating due to porosity if the "skin" of a zinc-based die-casting is polished through are eliminated, as there is no "skin" in the accepted sense. Polishing is also much cheaper and easier. Aluminium die-castings made by the process are said to be readily anodised in clear and coloured finishes without the irregular effects known to occur on conventional die-castings.

Other production claims for the process are that casting temperatures are lower and that wall sections can be substantially reduced without loss of casting strength, making such castings competitive with stampings. It is this latter feature which is likely to lead to a serious investigation of the advantages of the method in this country, particularly as it is adaptable to existing die-casting machinery. If the issue were simply one of making things easier for the plater, the interest of the die-casters would probably be somewhat tepid !

MAKING CORROSION PAY

IT is by no means impossible that in the course of the next few years, many machine shops with their rows of milling and turning machines, profile cutters, and so on, may acquire a new look ; spark machining is already here to stay and soon rows of tanks containing acids or alkalis, fume ducting, and steam coils may well eliminate even more machining operations. This situation is being brought about, in the U.S.A. especially, by the advent of etch-milling. In the aircraft industry fuselage skins, doors and wings are being regularly etched in this way using alkaline solutions at 115°F.-125°F. which remove metal exactly where required at a rate of up to .004 ins. per minute. More recently hydrochloric acid has been used, the concentration being maintained by introducing the gas into the solution. Tapering operations on shims, etc. are particularly easy to carry out, the parts being simply lowered into the bath at controlled speeds. Even titanium and stainless steel can be etch-milled in this way.

The chief attraction of the process is its cheapness, coupled with the low cost of the plant as compared with metal cutting machinery. Excess metal can be removed from inaccessible areas without endangering the strength of the parts, whilst sub-surface flaws are also readily shown up.

THE PUTTING-ON TOOL

IT is always interesting to see how a process or a business changes its emphasis as time goes on. In a recent brochure, one of the leading companies engaged in nickel plating for the purpose of building up worn parts, and which, in fact pioneered the process, now report that their main field is now in the plating of new articles rather than old ones. In this way a heavy nickel deposit enables components made of mild steel or aluminium for example, to be used under conditions in which the relatively low wear-resistance of these metals would make them entirely unsuitable.

Of course, mistakes will always be made, and the heavy nickel plating business has a steady source of income from such errors. This is a case where the prosperity of the plater depends to quite an extent on the irresponsibility or inefficiency of the customer.

ON THE RAILS

WE read that the Santa Fe Railroad has a motto that if a certain method has been in use for 5 years it is suspect, and if for 10 years, it is obsolete. By this token, many metal finishing establishments would not be shining examples of modernity. It may be some consolation however to know that there are worse industries. An exhibition at the Guildhall shows Roman building tools side by side with contemporary ones, and the differences in the design are negligible.

AT THE THIRD GLUB . . .

QUOTED in "Finishing Facts" the I.C.I. Paints Division News Letter, is the apocryphal but highly moral story of the man who was asked by a chemist to add a certain number of gallons of thinner to the paint in a dip tank to adjust the viscosity. The man simply up ended a five-gallon drum of thinner and poured some into the tank, whereupon the following conversation ensued.

Chemist : "How do you know how much thinner you have added."

Operative : "I count the glub-glubs."

Chemist : "What do you mean, count the glub-glubs ?"

Operative : "Well, you know how when you pour stuff out of a can it goes glub-glub-glub — well, I count the glub-glubs."

A Process for THE DEPOSITION OF MOLYBDENUM inside large-bore tubing

Reported by A. HEGARTY

THE National Research Corporation of Cambridge, Massachusetts, U.S.A., was recently awarded a research contract to develop equipment for coating the inside of steel tubes with molybdenum. The inside diameter of the tubes to be coated was about 1⅝ in. and the coated section about 2 ft. long.

Previous work at the Battelle Memorial Insitute[1] and at M.I.T.[2] had determined that high-purity molybdenum metal could be deposited at a high rate by the reduction of molybdenum pentachloride with hydrogen. The temperature for this reaction ranged between 650°C and 1100°C., and excess hydrogen was necessary to yield complete reduction and to prevent premature decomposition of the molybdenum pentachloride.

Work at National Research Corporation had revealed that :

1. The pressure at which reduction occurred most efficiently was approximately 20 mm. Hg.
2. The plate followed surface contours without building up at discontinuities.
3. High-purity molybdenum pentachloride required could be obtained by heating commercially pure $MoCl_5$ for an hour at a pressure of 1 mm. Hg. or less at 100°C.

Some details of the work by National Research Corporation was recently given by Paul L. Raymond, of National Research, before The American Electrochemical Society. With this general background it was proposed to coat the interior of tubes with molybdenum by hydrogen reduction of the pentachloride. The size of the tubes precluded the convenient use of an enclosed system for vacuum operation, and it was desirable to establish a system employing common engineering materials in order that tubes could be rapidly processed.

Equipment

The equipment for vapour plating is shown in the flow diagram (Fig. 1). Argon from high-pressure cylinders was heated and passed through molten molybdenum pentachloride. It was then mixed, as it passed through the lines, with heated hydrogen. The mixture of hydrogen, argon and molybdenum-pentachloride vapour entered the reaction tube where it passed upward through a heated zone. Metallic molybdenum was deposited on the walls in this heated zone through the reduction of the pentachloride by the hydrogen. The reaction gases passed through a filter to remove solid by-products were then exhausted to atmosphere, through a vacuum pump. The heated zone was slowly moved downward throughout the length of the tube as the plating progressed.

Except for a series of stainless-steel valves, the components containing molybdenum pentachloride and the products of the reaction were all mild steel or rubber. Operating temperatures of the vaporizer in use at the conclusion of the investigation did not exceed 250° C., so that only a slight amount of iron contamination was observed. It was possible to develop an exceptionally vacuum-tight system with this equipment and a pump-down to 20 microns with the original mechanical vacuum pump was possible throughout the programme. Rubber tubing was employed in some cases to facilitate connexions to flowmeters and manometers. Experience indicated that the most suitable gasket material for hot connexions at the reaction tube was compressed asbestos sheet packing. This material does not flow and it will withstand higher temperatures.

Hydrogen in high-pressure tanks was purified by a catalytic purifier followed by processing in a column filled with activated alumina and another filled with calcium hydride. Hydrogen from this system had a dewpoint below—70°C. Analyses of hydrogen made by mass spectrometer, indicated that no free oxygen was present and less than 100 p.p.m. of water vapour. Argon and helium, used for purging and as carriers for molybdenum pentachloride vapour, have extremely low dew-points as received and were used without further purification. Pressure regulators reduced gas pressures to approximately one atmosphere and a manifold permitted the flow of either hydrogen

or argon through rotameters to determine the flow rate. A pressure slightly above atmospheric was maintained in this system to preclude air from leaking into the system. Needle valves reduced the gas pressure to 5 to 20 m.m. Hg. and also controlled the flow. In as much as this was generally a steady state system, only slight adjustments were required during a plating run.

The gases were heated at atmospheric pressure by passing through a spiral finned resistance heater within an asbestos jacketed section of 1¼-in. iron pipe. Exit gas temperature was determined by thermocouples, and variable transformers were used to control power to the heating elements.

The molybdenum-pentachloride vaporizer consisted of a 4-in. diameter cylinder about 8 in. long with a hemispherical base and flanged top. Vapourizing gas was bubbled through the bath of molten molybdenum pentachloride and out through a pipe in the cover of the assembly. The entire assembly was immersed in a constant-temperature oil-bath to facilitate vaporization and to control the vapour concentration.

Throughout the investigation there were probably more changes in the vaporizer than in all the other components. Initially, heated hydrogen flowed past the molybdenum pentachloride suspended in a glass-cloth bag while the outside of the vaporizer, which then consisted of a flanged section of pipe, was heated by gas burners. Poor control of vapour concentration and premature partial reduction of pentachloride resulted from this system.

A mechanical screw-type feeder was then employed to regulate the flow of pentachloride to a heated plate where it was hoped flash evaporation would occur, thus giving a controlled molybdenum-pentachloride-hydrogen ratio. However, premature reduction and disproportionation were observed. Also, the feed screw became jammed frequently, resulting in no vapour.

The tank-type vaporizer was modified several times before the final model was developed. Initially, heated hydrogen was passed over molybdenum pentachloride placed on trays in the vaporizer picking up the vapour. It was hoped that a constant evaporation rate could be maintained, but due to changing surface conditions, the vapour concentration decreased as the run progressed. After several attempts it was decided to melt the molybdenum pentachloride. The vapour was then picked up in one hydrogen stream. Various amounts of partially reduced chlorides were observed in the reaction tube and the system appeared to contain dust which at times caused non-adherent coatings or nodules to be formed in the reaction zone. Using heated argon as the vapour carrier gas, the premature reduction of the pentachloride vapour was eliminated and much closer control of the vapour ratio obtained. Because of the high temperature of the argon and vapour, it was not necessary to control closely the temperature of the diluent hydrogen gas ; all that was required was to maintain the temperature of the resultant mixture above the dewpoint of the $MoCl_5$ vapour present. Two runs were carried out, utilizing helium as a carrier gas, with equally good results.

The molybdenum pentachloride was furnished in sealed 1-lb. glass bulbs. During filling the vaporizer a stream of dry argon or nitrogen was passed through the system to minimize the contamination by air and water vapour. A vacuum pump-down of the system to 40 microns and 100°C. on the vapourizer was used to eliminate volatile oxychloride.

Measurements

With the vaporizer operating at approximately atmospheric pressure, near saturation conditions of $MoCl_5$ in argon existed. By varying the temperature of the argon entering the vaporizer or the temperature of the oil bath, or both, it was possible to control closely the ratio of molybdenum pentachloride to argon. The diluting hydrogen stream was easily measured by a rotameter. Thus the desired molybdenum pentachloride to hydrogen ratio could be maintained throughout an extended run.

Reaction Tubes

Most of the plating runs utilized tubes made from commercially drawn steel tubing with an approximate composition comparable to AISI 4620. The internal surface of the tubes was highly polished. Initially metallic "O" rings were used as gaskets at the tube ends, but experience proved that the asbestos sheet material provided a tighter seal. Tubes were bored out to 1⅝ in. and finished to a surface of better than 16 micro-inches r.m.s. Various substrates were used as a basis for the molybdenum plate, in addition to cleaned but otherwise untreated steel. All tubes were carefully degreased with acetone. Electroplates of copper and of nickel and chemical plates of nickel and of cobalt were tested. Chemical plate was produced by the manner outlined by Brenner and Riddell[3] at the National Bureau of Standards. Since cobalt chemical coatings gave the best results in the early stages of development, all tubes used in the later stages were given this treatment.

Heating of the Reaction Tube

An induction heating coil was originally proposed for this study, but it was not possible to secure an adequate power supply in a reasonable time at the outset of the project. For the most part, heating of the tube was accomplished by an annular

high temperature gas burner mounted on a moving platform. The burner was moved downward counter to the feed flow in order to allow the molybdenum to be deposited on a clean surface. With a plating run starting at the upper end of the tube, any partially reduced products of the reaction were deposited on the plated surface and could easily be removed.

During the final two months of the project, a 25 kW. 9600-cycle induction generator became available and it was decided to investigate the effect of an extended reaction zone on the process. A heated zone of from 8 to 10 in. was desired in place of the narrow 2-in. zone available from the gas burner. It was determined that about 2½ to 3 kW. were required to maintain the tube at reaction temperature. This method of heating proved to be extremely successful, clean, easy to control and produced less scaling on the outside of the tube than the gas burner. The temperature of the external tube surface was measured by a thermocouple and a radiation pyrometer.

For all runs, secondary heating by infra-red lamps was utilized to maintain the temperature of the reaction tube above the condensation temperatures of molybdenum pentachloride. This was necessary to prevent a later vapourization and enrichment of the vapour mixture as the burner travelled down the tube.

Effect of Variables on Plating Quality

Throughout the investigation, the effects of the following variables on plate quality and thickness were studied : total pressure, temperature of reaction zone, vapour concentration, hydrogen flow rate, surface preparation, and direction and rate of travel of the burner. The following were found to be the optimum conditions using the equipment described :

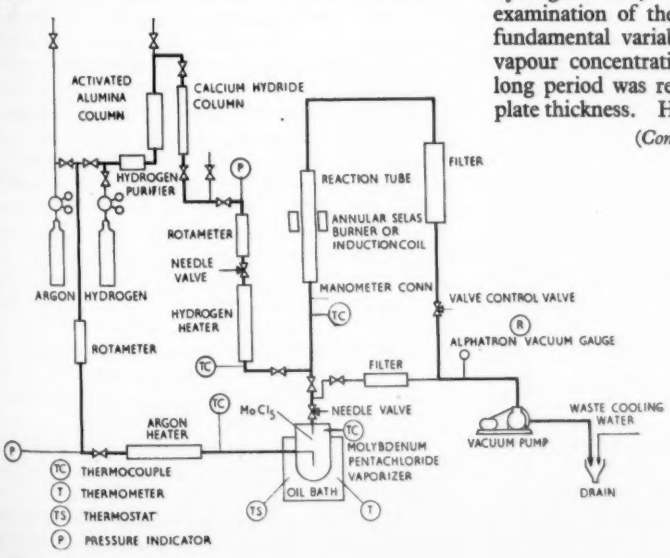
1. Total reaction pressure, 15 to 20 mm. Hg.
2. Tube temperature 900 to 950°C., measured externally.
3. Rate of travel of burner in the downward direction, 2 in. per hour.
4. Hydrogen flow 7 to 9 litres per minute, measured during standard conditions.

When the pressure in the reaction tube rose above 20 mm., a vapour-phase reduction occurred and the deposit became porous and non-adherent due to deposition of molybdenum particles which did not form a continuous coating. Below 10-mm. total pressure, it was impossible to obtain an adequate concentration of molybdenum pentachloride vapour to provide a sufficiently high rate of deposition. Most of the work was carried out at a pressure of 17 mm. Hg.

The external temperature of the reaction zone as determined optically was usually between 875°C. and 975°C. These temperatures were correlated by thermocouples early in the project to the internal tube temperature. Temperatures below 875°C. were not high enough to produce complete reduction at the existing gas velocities. Above 975°C. there was an increased tendency toward formation of large amounts of external scaling and decarburizing of the tube surface. No advantage in internal plate quality was gained by operating at temperatures in excess of 975°C.

While it was not possible to determine quantitatively the actual molybdenum-pentachloride/hydrogen ratio, it was quite evident from the examination of the data that this was one of the fundamental variables of the process. When the vapour concentration was too low, an excessively long period was required to build up an adequate plate thickness. However, when very lean mixtures

(*Continued in page* 352)



Flow diagram of process and equipment for vapour plating molybdenum inside large-bore tubing.

Deposition of Molybdenum

(*Continued from page* 351)

were used, the plate appeared to be dense and well bonded. With a high ratio of molybdenum pentachloride to hydrogen in the vapour, a porous non-adherent coating was deposited. In the latter case there was a tendency for the coating to be much thicker, but because of side reactions, voids were apparent between the molybdenum and the base metal. Considerable effort was expended in an attempt to establish a means of determining quantitatively the molybdenum-pentachloride/hydrogen ratio, but without success.

From the examination of a large number of plating runs, the conclusion was reached that downward travel of the burner consistently produced the best results. As the vapour mixture flowed through the heated zone, the reduction to metallic molybdenum was only partially complete. Some lower molybdenum chlorides were also produced, which deposited on the internal tube surface in the cool zone. If the burner moved concurrently with the flow, these lower chlorides might not be revapourized before they reached reduction temperature. This resulted in a porous or powdery deposit with little or no adherence of the subsequent metallic plate. If, on the other hand, the heater was moved downward, incompletely reduced chlorides would be deposited on plate which had already been laid down and would be subjected to no additional heating. As the heater moved down, the plate would be deposited on a fresh clean surface. Unreduced chlorides were removed when necessary by wire brushing.

Because of the reaction of the molybdenum and the carbon of the steel it was determined early in the project that a barrier must be established to prevent this from occurring. Copper, nickel, and cobalt plates in various thicknesses were tried, and the best results were obtained using a cobalt underplate of about 0.00025 in.

It was very difficult to establish quantitative means of determining the adherence of the plate to the base material. Several of the best coatings were subjected to bending tests to determine the angle through which the plate and base material could be deformed before separation of the plate occurred. It was observed that the heavier the plate, the more readily it fractured. When examined under a low-power microscope, it was evident that the molybdenum failed in tension and this was indicated by many transverse cracks extending to the base material. The cobalt plate below the molybdenum remained intact during the bend tests.

A further indication of the quality of the molybdenum plate was obtained by observing the tube when it was sawed for sampling. A good adherent plate would cut with the base material and would roll over with the cut edge.

Conclusions

The process and techniques have been developed for the production of relatively heavy molybdenum plates inside of tubes. There should be uses for such plates in the chemical-engineering field to take advantage of the mechanical strength and resistance to abrasion and erosion of molybdenum, as well as its high chemical and corrosion resistance. In the presence of air, at elevated temperatures, molybdenum undergoes catastrophic oxidation. However, for many uses in high-temperature, high-pressure reactors, this material could well be the answer to erosion problems where non-oxidizing conditions exist.

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AUTOMATION AND ELECTROPLATING

"THE advantages of automatic plating plants are very considerable, and are by no means confined to the obvious one of a saving in direct labour used in plating operations. Automatic equipment gives a guaranteed output of a certain number of components per hour, and the quality of the plating and its thickness are controlled at the same time. Perhaps more important is the fact that the pre-cleaning cycle upon which satisfactory plating depends so greatly is likewise consistently carried out. These factors cannot be guaranteed in a manually operated plant, and the introduction of incentive systems may actually tend to increase the amount of faulty work in processes such as electroplating, which demand attention to detail. A high proportion of rejects from the plating operation or poor performance in subsequent service are both serious to the manufacturer.

Re-processing of defectively plated work is a costly procedure, even when it is successfully done, which is by no means always the case . . ."

The foregoing is the introductory statement to a brochure entitled "Automation and Electroplating," published by Electro-Chemical Engineering Co. Ltd., Sheerwater, Woking, Surrey.

The brochure goes on to examine the basic requirements of mechanization as applied to electroplating processes, and reviews the development of automatic plant. It describes in brief, a number of plants installed by the company.

A Survey of AIR TREATMENT SYSTEMS in use in the Metal-Finishing Industries

by LEO WALTER, A.M.I.H.V.E., A.M.I.Plant.E.

(*Series concluded from page* 338, *August*, 1957)

AIR FILTRATION SYSTEMS

CLEAN, dry air is required during assembly operations of metal parts for precision machining. It is also important for lacquering work, as the coatings require moving air for carrying away vaporized solvents or water vapours evaporated during the drying period. If, for example, small metal parts are painted and then exposed to natural air drying on shelves, impurities in the air of the shop might settle down on the finish coating and spoil it. Modern stoving arrangements for painted or lacquered metal parts likewise require clean air, whether convection or infra-red drying methods are employed. In either case, an air stream is essential for carrying away vapours, but this air stream also comes into contact with the surface finish and in order not to contaminate it, the air should be filtered.

Work in the cleaned and freshened air which modern ventilation can give to workpeople will be performed in comfort and under hygienic conditions. It is well to realize that no ventilation system can be better than its air filter and many a plenum heating system or a heating system using unit heaters could be greatly improved by adding an efficient air filter to the fresh-air inlet. It is this air filter which collects and retains dust and dirt, always present in air. The same applies to an air filter in a re-circulation duct, which holds back air-borne impurities. Air filtration is, of course, an essential job for any air-conditioning system in a factory and scientific air filtration should form an integral part of the system.

Duties of Air Filters

Dust particles in the air vary in size from those visible to those only detectable under the microscope. Research figures dating back to 1935 revealed the following data for average deposits of airborne particles per square mile : London 276 tons, Sheffield 255 tons, Birmingham 195 tons. Things have certainly not improved since, and the "Clean Air Bill" to be introduced quotes astonishing figures for soot deposition. For example, research work indicated in 1950 that about 2 million tons of coal per annum comes down from the air in the form of soot and smoke in U.K. Dust concentration in industrial areas is said to be over 5 million particles per cubic foot of air. No wonder certain processes require air filtration as part of the process itself, such as processing of food, of photographic plates, artificial silks, tobacco, certain fine chemicals, pharmaceuticals and antibiotics, and many more.

The choice of air filter type depends on the following factors : (1) purpose of air filtration ; (2) space available ; (3) first installation cost ; (4) maintenance personnel available, and (5) maintenance cost. Thus from the wide choice, ranging from simple cotton-wool filters to electrostatic air filters (producing up to 99.9 per cent. removal by weight of all solid foreign matter) practically all requirements can be met.

Various methods are used for measuring air pollution. For convenience dust particles are measured by the metric unit known as the "micron." This has a size of 1/1,000 mm. or 1/25,000 in. Bacteria or spores, of vital importance in air cleaning for food processing, require special filtering methods due to their very small size. Particles exhausted from factory chimneys and furnace stacks can be quite sizable, and may be extricated from the flue gases either by centrifugal force in cyclones, or by washing the flue gases with water sprays, or by electrostatic precipitation.

Room Air Filters

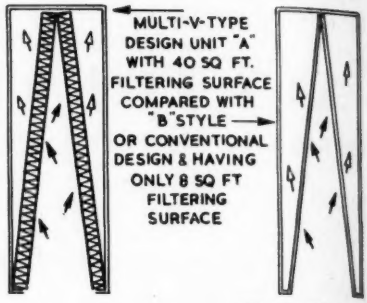
Typical filters for room air consist of a frame made from metal, wood, etc., and a filtering medium through which the air passes. Several filter units can be assembled within a single frame and several units might form banks of air filters in large systems. The airborne solid matter can be dirt or dust, and lint, which latter may be animal hair, vegetable fibres, textile fibres, etc. It depends on the nature or size of the dust, however, as to whether the particles can be easily captured by one of the more conventional mechanical air filter types, or whether very fine particles have to be dealt with specially by using electrostatic air filters. The filtering of air normally requires a reasonable efficiency of air filtration, but special air filters which remove finer particles are preferable for certain assembly operations of precision products where extreme cleanliness is essential (Fig. 1).

A wide variety of air filters is available. Air

filters can be broadly classified into viscous filters, dry filters, air washers, centrifugal devices and electrical precipitators. Air filter types are usually non-automatic, and have either to be manually cleaned at regular periods of time or have replacement filter elements (throwaway types). A few types are designed for continuous automatic cleaning such as, for example, rotating filter elements wetted with oil, which filters continuously dip their elements in an oil trough, thus cleaning same (Fig. 2).

The name "viscous filter" implies that the filter elements have to be wetted with a viscous substance such as oil or grease, which acts on the flypaper principle and catches the dust particles which come into contact with it. In practical operation, the air stream is broken into small streams, which are forced to change direction abruptly a number of times, thus throwing solid particles against the adhesive and making them stick as the cleaned air flows through.

The fibre material used in filter elements can be glass fibre (Fig. 3), metal wool or wire screen, and small filter ferrules can also be used. Another type of filter cell has oil-coated metal rings or small hollow cylinders held in place by a wire screen, the air stream being split into numerous thin streams during its passage when the solid particles fall out and are retained in the ring surface. Possible methods of arranging filter elements to provide an enlarged filtering surface and a reduced pressure



(Courtesy Vokes Ltd.)

Fig. 1. Multi-Vee type cotton filter

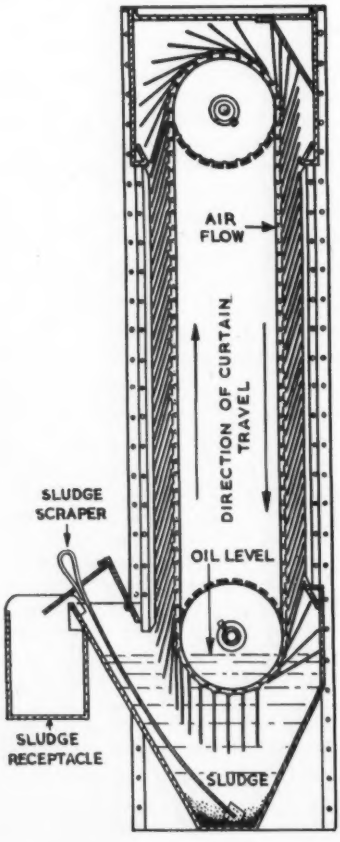
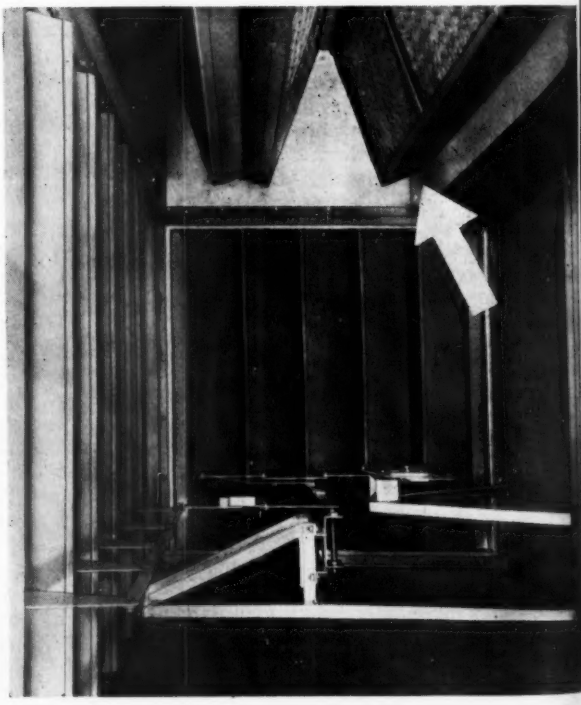


Fig. 2.—left. Automatic, self-cleaning viscous A.C.I. air filter
(Courtesy Air Control Installations Ltd.)

Fig. 3.—below. Glass filament filter in unit air conditioner
(Courtesy The Air Treatment Engineering Co. Ltd.)



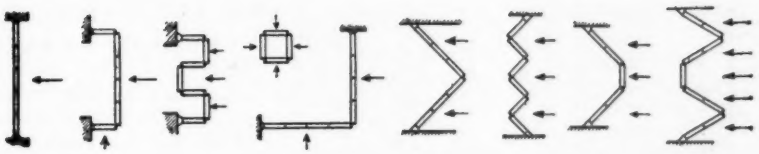


Fig. 4—Various methods of arranging air filter elements.

drop of the air are numerous, and can be in parallel or grouped in series (Fig. 4).

One type of rotating, self-cleaning viscous filter is all metal and uses oil-covered surfaces ; with these, a handle is normally turned once in 24 hours, lowering a used element into a cleaning bath at the bottom. Another heavier duty type uses oil sprays for cleaning the element (Fig. 5).

Automatic filters with a moving cloth element have been designed, in which the elements are supported on rollers and are moved slowly and continuously across the air stream by means of a motor drive. In other types, a series of special metal frames is mounted on a pair of chains, and the elements move as a continuous curtain up one side and down the other side of the sprockets which support the chains. The resistance of these automatic filters will generally remain constant during operation, whereas the filter resistance of ordinary viscous filters increases with their use. Air jet cleaners can be used for keeping the filter surfaces continuously clean. In another rotary type filter, both curtains can be arranged to travel anti-clockwise (Fig. 6).

Dry Air Filters

The essential requirements of an efficient dry air filter are good design, sound construction, efficiency in filtering, low maintenance cost and easy cleaning or replacement of elements (Fig. 7). The usual filtering substances in dry air filters are fabrics or fabric-like materials. A dry filter using felt in pocket form achieves a larger filtering surface in a smaller space. Other materials which divide the flowing air into very fine streams are cotton fabrics, cellulose, glass fibres, etc. Replaceable elements can be made from cellulose fibres, packed

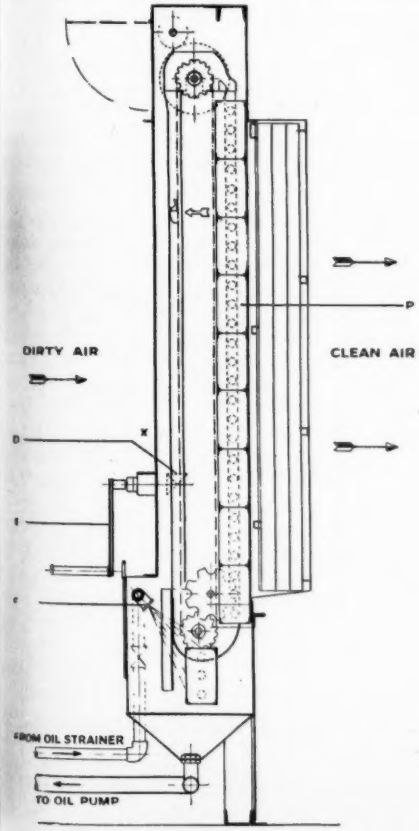
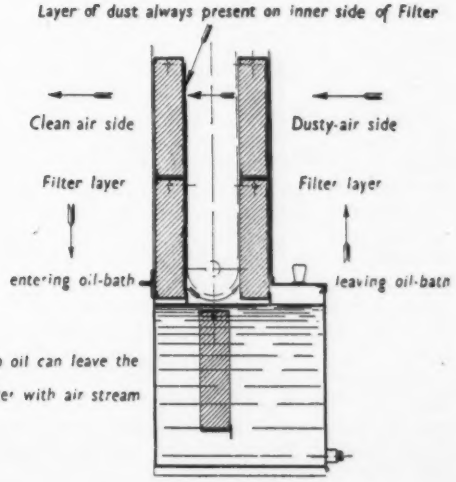


Fig. 5—(left) Rotary type filter with oil spray for cleaning the filter element.
d. Bevel wheel drive ; e. handle ; f. oil spray nozzles ; p. filter cells.
(Courtesy Visco Engineering Co. Ltd.)

Fig. 6—(below) Rotary filter operating on paternoster principle.
(Courtesy Matthews and Yates Ltd.)



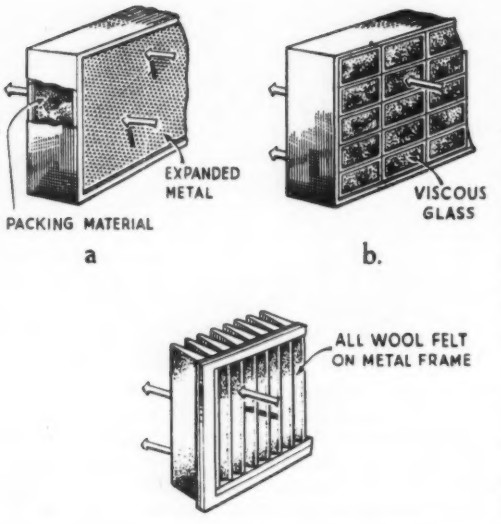


Fig. 7.—Various types of air filter elements.

into a frame holding wire cloth packed with flexible spun glass strands. With these, there is no absorption, and hot or cold water can be used for cleaning. In air conditioning a very useful air conditioning and filtering unit of self-contained design uses fibre glass filters (Fig. 8).

Air Washers

It is well known that a water mist will purify a stream of air. The cleaning capacity of water sprays is utilized in air washers, in which one or more banks of water sprays are used to produce a curtain of water mist through which the treated air has to pass. The fine droplets remove the dust from the air, which leaves the washer in a clean condition. Air washers of various types are extensively used in air-conditioning plants, not only for cleaning but also for air cooling, and for humidifying or for dehumidifying the treated air. It may appear strange that the use of water sprays can dehumidify the treated air, but this is done by means of chilled- or cold-water sprays which condense the existing water vapour in the air stream, so that the humidity is lowered. When the air is heated up after the air washer to normal room temperature, it is actually much drier than when it has entered the air washer chamber, and it is very clean (Fig. 9).

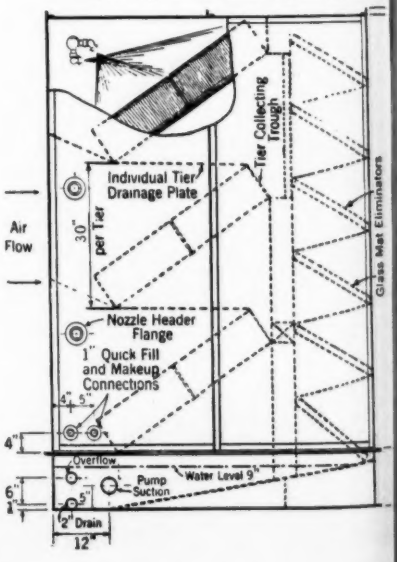
Filter washers employ filter pads in conjunction with water sprays. They can be designed for cleaning and humidifying air, and it is claimed by the makers that they remove all dust and dirt from treated air to micrometric fineness.

Electrostatic Filters

A filter which is finding increasing use for air cleaning is the electrostatic type. The basic principle of all electrostatic filter types depend on small, solid dust particles exposed to an electrostatic field assuming an electric charge and then being attracted towards an electrode placed in the path of the air stream. The ionizing field usually requires a few thousand volts between plates for the precipitation of dust. The precipitators are available in both automatic and non-automatic filter, and are made in various capacities to suit their respective duties : the main reason for their popularity is their high efficiency.

An example of these is the Sturtevant " Precipitron " air filter (Fig. 00). It consists basically of three major parts, the dust collector, the ionizing unit, and the power pack with metal or electronic valve rectifiers. The ionizing unit comprises a number of earthed tubes, and between each tube and its neighbour a fine metal wire, with an electrical charge in the region of 13,000 v. d.c., is stretched between each tube and its neighbour. A strong electrostatic field is thus produced, and a corona discharge develops from the wire. Ionization of the air molecules takes place and a dust particle passing through is immediately ionized and becomes ready for deposition on a collecting surface. The latter is in the form of a collector cell, consisting of a number of flat parallel plates, of which one set is earthed and the second set charged to about

Fig. 8.—Glass mat filters and eliminators as used in an air washer in a conditioning system.
(Courtesy Air Treatment Engineering Co. Ltd.



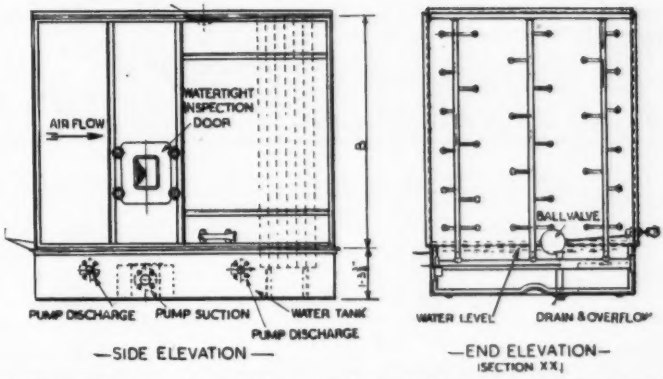


Fig. 9.—Air washer chamber with water sprays.

6,000 v. The plates are arranged alternately, so that the air and dust flow down narrow passages. There is no discharge in this part of the unit, so that the ionized dust particle enters the collector or plate section, where the force of the electrostatic field drives the charged particle against an earthed plate where it adheres until it is removed during the cleaning operation. The electric current is provided by a power unit which includes a high-tension transformer which steps up the line voltage to approximately 6,000 v. for the collector plates and 13,000 v. for the ionizing wires by means of metal or electronic valve rectifiers. One of the advantages claimed for this type of filter is that its resistance to air flow remains constant and does not increase with use, provided that it is not allowed to become completely choked with dust.

Choice of Filters

No hard-and-fast rules can be given as to the best selection of filter type for finishing operations, since everything depends on local circumstances, that is, on the degree of air cleanliness required, on the volume and quality of the air to be treated and on the first installation cost of a filtering plant. It is probably advisable to consult an expert before deciding which tender to accept, and experience with a certain filter make in a similar plant will be of some guidance, provided that working conditions are similar. Whether to use a dry or a wet (viscous) filter type depends on local circumstances and on the required cleanliness of air. Reputable makers of air filters will carefully investigate the conditions, and then put forward their recommendations with certain guarantees for air cleanliness.

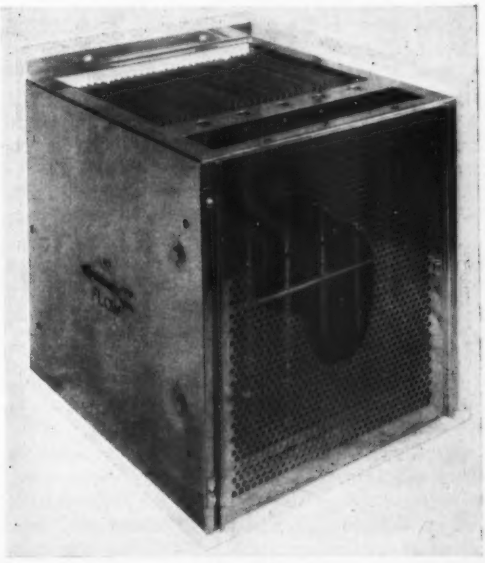
The user of air filters is well advised to keep his requirements reasonable but, after having decided to use a certain filter type or plant, to make sure that these requirements are met. An air filter has to be adequately sized. The rating of an air filter is the air-flow volume for which it has been designed and, by dividing the air flow through the duct area, the actual face velocity of the air can be obtained : the latter may be 250 to 500 ft. per min. It is important for the user to know that the resistance of a new filter will remain reasonable for long periods. Filter resistance for clean and for operated filters determines the power for moving the air, that is, the power consumption of a fan motor.

The ratio between the dust taken out by a filter and the dust content of uncleaned air is a measure-

(*Continued in page* 359)

Fig. 10.—A typical Preciptron cell with the perforated baffle cut away to show the ioniser and plate collector system beyond. This particular cell has a face dimension of 2 ft. x 2 ft. and will accept 2,000 c.f.m. of air, reducing its staining effect to less than 1/6th.

(Courtesy Sturtevant Engineering Co. Ltd.)



FINISHING POST

A SELECTION OF READERS' VIEWS COMMENTS AND QUERIES ON METAL FINISHING SUBJECTS . . . . .

Advice on all aspects of metal finishing practice is offered on these pages, and while every care is taken to ensure the accuracy of information supplied no responsibility can be accepted for any loss which may arise in respect of any errors or omissions.

The Peen Plating Process — Some facts and Figures

Dear Sir,

May I, in further connexion with the discussion appearing in the April 1957 issue of METAL FINISHING JOURNAL, relating to the peen plate method of metal cladding, and in the light of some ten years of association with the research and commercial aspects of this plating method, trespass on your indulgence to make certain comments on some of the points raised in the discussion following presentation of the paper by Dr. T. P. Hoar and Mr. Gordon Jenner.

The economic value of peen plate as a competitive process was questioned. Inasmuch as this method is competitive with both electroplate and hot dip, it will be necessary to evaluate the economics in both of these fields separately.

Dealing first with the question of electroplating hardware, the most economical type is barrel electroplating. Mr. A. W. Wallbank states that he was not convinced that there was much of a place for the "Peen Plating" process between barrel plating on the one hand and flake galvanizing on the other; the two prominent methods of plating zinc in bulk on steel articles.

In all electroplating including barrel plating, we are involved with problems of surface area; the greater the surface area per pound the higher the cost. Not only is the barrel electroplater concerned with surface area per pound, he also wrestles with the problems of generator and cathode efficiency, solution dragout, anode waste, and effluent disposal problems. He requires skilled labour and he must usually apply some sort of passivation treatment to his bright zinc if it is not to tarnish immediately. The peen plate operator gets off far more lightly.

Coupled with this statement is a suggestion that the degree of mechanization required to get labour costs down would be comparable to that of an electroplating facility of equal capacity. The implication of this is that peen plate requires as much mechanization, and, consequently, investment as electroplating. It overlooks the fact that in largely automatic electroplating the initial cost, including generating facilities, and the attendant depreciation and amortization, are many times what is required in the essentially tumbling operation constituted by peen plate.

Dr. D. N. Layton of Ionic Plating Co. feels that a plater would not be pleased to hear 5 per cent of the zinc was thrown away; but (disregarding equivalent loss sources for electroplating, anode waste and solution dragout) the proportion of total plating costs constituted by 5 per cent of the zinc used, averaged among U.S. licensees is a fraction of 1 per cent of the overall cost of the operation for coatings of less than .0005 in.

Mr. E. A. Ollard of the Atlas Plating Works offers the opinion that zinc is no cheaper in suitable powdered form than in anode form. While we cannot speak for the United Kingdom, the price ratio of suitable dust to anode zinc averages 75 per cent over here. Pertinent to this subject is Mr. Wallbank's suggestion that the peen plate process needs a "highly pure zinc powder" or it does not work. Actually, a normal, commercial grade of condensed zinc dust is used in the United States, prepared by condensation from secondary zinc. Its purity is well below that represented by the "four-nine" electrolytic zinc bearing the name "premium" that was first introduced to our commerce by Tainton. Dusts of zinc alloyed with other metals throughout the range from $\frac{1}{2}$ to 70 per cent of other metals have been successfully peen plated.

Mr. Ollard also feels that to be economical, five tons per day of work should be plated. The economics of the situation in the United States are such that users of the process range down to 2.2 cwt per day. The user plating this quantity is plating tacks and small staples which are plated in both the galvanized and electroplate thicknesses. Costs for this firm over a three-year average have shown total savings of 42 per cent over previous costs. There are several users of the process in the range from 7-16 cwt per day.

In this same connexion it should be borne in mind that operators producing small quantities generally prefer to add jobber profits to their plating bill rather than involve themselves in the high initial expense as well as the refined control and maintenance necessary for superior electroplating and desirable for superior hot dipping. The significance of this comment lies, of course,

(*Continued in page* 359)

The Peen Plating Process — Some Facts and Figures

(*Continued from page* 358)

in the fact that for practical purposes electroplating costs to the small operator and the costs of electroplating at his jobber's door are two different things, or custom plating establishments wouldn't exist.

Turning next to the question of comparative costs between the peen plate process and flake galvanizing. Mr. Wallbank has rather lightly dismissed this by saying that he did not see how "it could compare with flake galvanizing where the nails were simply thrown into the drum and a load of flake thrown in." To begin with, the uniformity of the zinc coating from nail to nail and from one part of the same nail to another varies considerably in flake galvanizing. It is difficult to control the coating thickness and, generally speaking, thinner coatings are difficult to achieve. The manufacture of the zinc in flake or "mossy" form costs something, and so do the various fluxes that are generally thrown in along with the flake and the zinc. There are substantial maintenance and replacement costs in connexion with the revolving barrels, and heat for the operation is also a factor. Careful studies made over here by two of our largest nail producers have shown definite cost advantages for the peen plated nails (the objects chosen by Mr. Wallbank) when compared with modern, refined, barrel galvanizing. An important part of these savings comes from more economical use of less zinc which, none the less, results in objects meeting the same tests. This is because of the relatively greater uniformity, not only over all surfaces of the nail, but also from nail to nail. Taking $1\frac{1}{4}$ in. x 11 standard roofing nails, for example, savings of $3\frac{1}{2}$ lb. of zinc. per 100 lb. of coated nails have been regularly achieved to meet the same tests. Incidentally, nail batches of up to 2,500 lb. have been processed and this bulk handling constitutes another important element of saving.

As a further, general comment on the relative economics of the method compared with open-tank galvanizing of small objects, your readers will be aware that losses due to dross, fume and skimmings may exceed 50 per cent, which compares with the 2-5 per cent losses experienced in peen plating galvanized thicknesses.

To date, it can be said that competent United States industry is using the peen plate process in substitution for previous methods, and that in all cases the decision has been, in the last analysis, an economic one — since specifications could be and had been met by use of either of the two older methods plus whatever subsidiary treatments were required.

In summary, it may help to give some perspective on the relative economics of the method if it is realized that, provided with suitably prepared objects, peen plating is an operation essentially comparable to tumble finishing from an operational and equipment point of view ; and its raw material costs differ from ordinary tumble finishing only by the value of the metal added and whatever difference in cost may exist between its chemicals and those used by the modern tumble finisher.

Yours very truly,

ROLFE POTTBERG.

The Tainton Company,
Baltimore, 11, Md.,
U.S.A.

Air Treatment Systems

(*Concluded from page* 357)

ment for general air filter efficiency, which is given in manufacturers' literature or in estimates as a percentage figure. Obviously, large dust or dirt particles and lint are more easily removed than very fine particles, and the latter problem often requires duplex filters, having very large filter surfaces and special filtering material. Tests for cleanliness of air consist of drawing samples of air through special filter papers simultaneously for cleaned air and for uncleaned air.

A few suggestions may be given for the choice of a filter type. Very dry lint can usually be extracted by dry filter types. For greasy lint, or where oil vapour exists in the air, either a replaceable dry filter or viscous filters should be used. Throw-away filters can be fitted in series, so that the front filter can be renewed, and the following units can be moved to the front.

Maintenance

The main point, after correct selection of the filter type, is preventive maintenance of the filtering equipment. The efficiency of any filter type decreases as time goes by and the filtering elements become laden with dust or lint, which increases resistance to air flow so that the air volume drops. It should be carefully ascertained what is the time of operation after which a filter element must be cleaned by the maintenance staff. Filter resistance in air ducts can be measured by quite simple means, if the air pressure in front and after the filter is gauged by a suitable measuring instrument, such as a U-tube manometer or draught gauge. Progressive incrustation of filter elements will increase the pressure difference, and the makers of the filter will advise what is the maximum allowable resistance of a filter that can be tolerated before cleaning is performed.

How GENERAL MOTORS Corp. Reduce Barrelling Times by

GYROFINISHING

A NEW finishing process developed by General Motors of Detroit, U.S.A., is being used for the abrasive finishings of metal surfaces prior to electro-plating. This method originated from an investigation of conventional barrel finishing with the object of reducing processing time. In barrel finishing the relative movement or sliding action between the components and the abrasive material gives the desired finish on the parts. Factors influencing quality of finish and time required are related to barrel size and speed, the size, type and quantity of the abrasive particles, the ratio of components to abrasive chips, and the water level. As part of the investigation the axis end of a barrel was covered with translucent plastic sheet to allow visual observation.

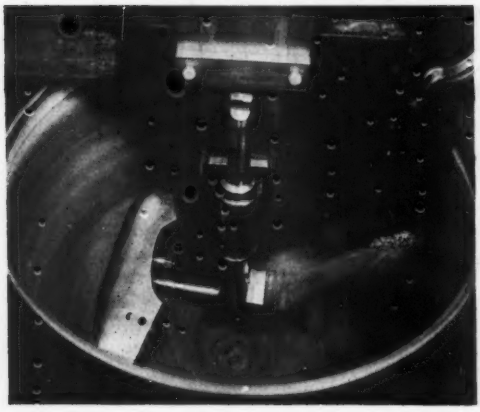
An analysis of the cascading action in the barrel suggested that an increase in the relative speed between the parts and the abrasive material could be advantageous. This could not be done in the barrel because increased speed of rotation caused the abrasive material and the parts to pack against the wall of the drum as a solid mass. It became apparent that some means had to be found to hold the parts in position to allow the revolving bed of abrasive to pass at increased velocity over the surface.

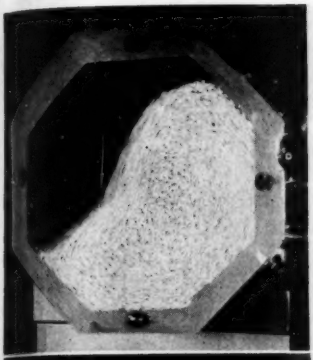
An experiment was initiated which led ultimately to "gyrofinishing," as the new process was then called. A 2-ft. dia. drum was built to rotate on a vertical axis so that the abrasive mixture would be retained when spun. A shaft was mounted so that one end could be submerged while holding the parts to be finished. Several abrasives were tried before a satisfactory result was obtained. Using diecast door handles for these first experiments an acceptable finish was obtained within minutes instead of the hours required by barrel finishing.

A larger machine was then built to study the process. By using harder abrasives it was found that steel, as well as zinc-alloy material, could be

Fig. 1—(*right*) *Initial experiments on the Gyrofinishing principle were carried out in this small, vertically mounted, rotating barrel.*

Fig. 2—(*below*) *Further experiments were carried out in larger equipment in which it was found that steel as well as zinc-base alloys could be finished by the use of harder abrasives. Illustrated here is the flow of the abrasive mixture over a steel bumper guard.*





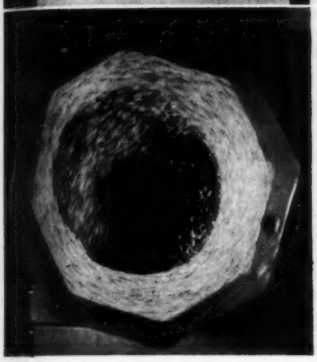


Fig. 3.—(top, left) An experimental finishing barrel in which it is possible to watch the process by the use of a transparent plastic cover. At excessive speeds of rotation relative movement between the barrel and its contents ceases.

Fig. 4.—(below left) At high speeds of rotation the medium is carried round with the barrel. Effective abrasive action could be obtained if parts were to be rigidly immersed in the rotating medium.

Fig. 5.—(right) In this experimental single station vertical Gyrofinishing machine an air cylinder is used for raising and lowering the parts into the abrasive. The spindles, which can also be rotated, carry fixtures to which the parts for finishing are attached.

satisfactorily treated. An experimental single-station was then designed and an air-operated power cylinder was attached to the machine head to enable parts to be lowered into the abrasive mixture. Revolving spindles were mounted on a geared head at 90 deg. to the vertical drum and bolted to the spindles were fixtures to hold the parts for finishing.

During the experiments, parts made from aluminium, brass and stainless steel, also were polished successfully.

A still larger more versatile machine ultimately brought gyrofinishing from the "pilot" stage into the workshops. It is claimed that in comparison with conventional polishing or buffing operations a gyrofinished surface on zinc-alloy diecast parts is a shade lower in colour than a buffed surface, and

(*Continued in page* 362)

Fig. 6.—A selection of typical parts on which a difficult and costly buffing operation has been successfully replaced by Gyrofinishing prior to plating.

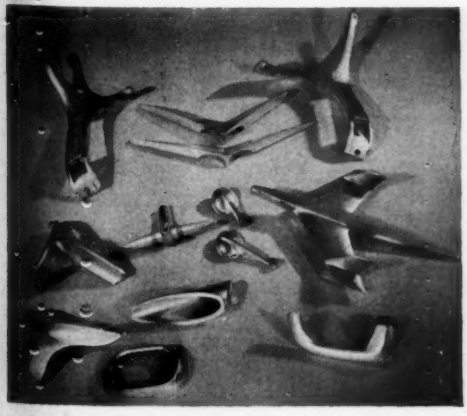
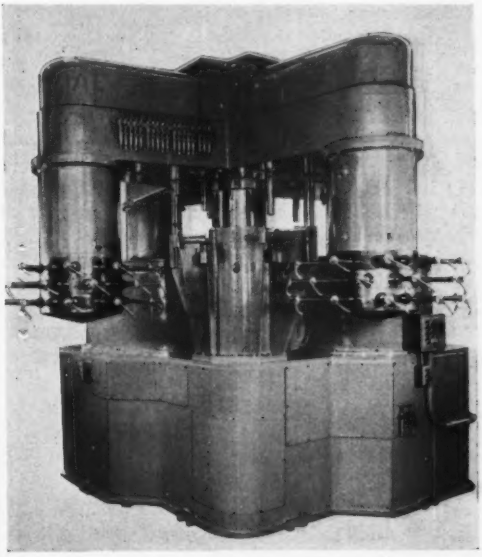


Fig. 7.—An early Gyrofinishing machine built as a multiple station machine used for surface finishing such hardware items as door handles.



Gyrofinishing

(*Continued from page* 361)

directional or flow lines may be more pronounced than with buffing. The greatest savings may be expected from odd-shaped decorative parts of household goods, automotive parts, and the like.

The result of these experimental studies was the introduction of gyrofinishing machines, built by General Motors, to the company's various works. One of the earlier machines was a multiple station type design for finishing automotive interior door hardware. A later machine was a three-station machine with feathering spindles and abrasive collection troughs.

An inherent disadvantage of the vertical design, namely loss of time during the indexing of spindle heads from drum to drum in a multi-station machine was overcome as follows. A horizontal machine was developed having the parts carried into the single open end of the drum on a conveyor supported by a cantilever beam. The parts are then rotated or feathered by means of cams. Parts are loaded or unloaded outside the drum while the conveyor is in motion. This cantilever horizontal machine is under continued development for further improvements. A screw conveyor is provided to convey, load, and replenish the abrasive material into the drum while it is in motion. The spindles on which the parts are mounted do not rotate in the unload-load stations. They can be cammed to position the parts to assist in unloading and loading. It is claimed that many parts lend themselves to automatic unloading.

Fig. 8—A later machine designed as a three-station Gyrofinisher. The processing heads are here shown in the raised position.

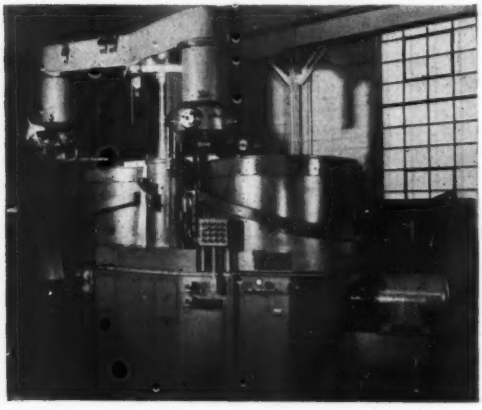


Fig. 9—A horizontal Gyrofinishing machine for processing parts carried on a conveyor. The parts are rotated by cams within the drum while abrasive is loaded and replenished by a screw conveyor into the drum while it is in motion.

Reference

Squibb, George R. and Hall, Fred T. "A Manufacturing Development: The Gyrofinishing Process for Polishing Metal Surfaces." *General Motors Engineering Journal*, 1956, May-June.

PAINT PRODUCTION IN BRITAIN

NINETY-THREE million gallons of paint and varnish products were sold in this country during 1956, compared with 79 million in 1953 and 80 million in 1948, according to figures published in a recent issue of Economic Trends, published by the Board of Trade.

In the 1956 total, only distempers and other paste paints show any decline (11 million gal. in 1956 as against 16 million in 1948). Cellulose-based paints have risen, in the same period,from 7 to 11 million, ready-mixed paints from 53 to 62 million and "unclassified" products from 4 to 5 million. Emulsion paints are not quoted as being on sale in 1948, but 4 million gal. were disposed of in 1956 compared with 3 million in 1953. Exports amounted to 12.2 per cent of production in 1956; and in 1953, the percentage was only 10.8, although in 1948 it was approximately 12.

Building paints, industrial finishes and "direct exports" provide the main outlets for paint sales. There have been noticeable shifts in the sales of different types of paints in recent years, as a result of research for industrial finishes which dry quickly and for household paints for the amateur.

The turnover of the paint industry is now more than £100 million annually and, of its 600 or so firms, about three dozen are responsible for half the total output. It is second in size only to the U.S. paint industry and the volume of its exports is higher than that of the rest of Europe together.

Paint Spraying *to measure**

By B. van der BRUGGEN

THE rapid development of mechanical methods of applying paint has brought in its train increased powder demand and rising investment costs. These factors, coupled with higher wage demands and the growing difficulty of finding suitable labour, have led to the words " Time is Money " being a major consideration in all painting establishments — at least, they should be so.

When time and material costs have to be compared, particularly the time factor which both directly and indirectly influences all the ancillary activities of the paint shop, it is today in the rarest cases that any attention is paid to the greatest possible economy of materials, however important that factor should appear to be. The main problem to be considered is what volume of output can be attained, in unit time with the least time costs ! In determining this, the time costs should not, as is still all too frequently done, be evaluated for a single work sequence or section of the plant, but should cover the whole production flow, including transportation, intermediate set-down and handling times.

Investigations in the paint shops of a number of different manufacturing industries have shown that an acceleration of the work tempo can be useful even when accompanied by an unavoidable increase in material consumption.

Such a wastage of material, usually paint, caused by acceleration, *i.e.*, mechanization of the production flow is, however, comparatively rare, and can be kept within reasonable limits. In the sphere of industrial painting, a form of priority for time-conditioned costs has developed ; but it is not always, nor everywhere, given sufficient attention, or allowed for in plant renovation and renewal.

The still too frequent use of static installations for surface treatment, with consequently slower work flow, primarily designed for material economy, is partly due to the circumstance that material expenditure can be accurately controlled. The time-based costs in painting work, on the other hand, are usually of a manifold nature and the indirect effects of slower working methods, extending beyond the paintshop proper, are not given sufficient attention, nor are they easy to evaluate.

The natural limitations to knowledge on the commercial side of the management with regard to the purely practical side of painting work and the frequent uncertainty of supervisory staffs trained and accustomed to static working methods in assessing the possibilities of conveyor-belt working impede and delay a decision in favour of rationalized, continuous flow production.

This applies especially in regard to manual paint application, which is one of the most frequent — and most expensive — operations executed in the paint shop, which is even nowadays only replaceable, whether wholly or partially, by fully-automatic or electrostatic methods of paint application, in the case of large production series of similar or identical suitably shaped work-pieces.

In many large and medium undertakings it is already an accepted practice to study piece movements in spraying, drying, etc., and, where appropriate, to organize the entire work flow, or the piece movements between work stages, on a basis of mechanical conveying. In not a few undertakings, however, the question of mechanized conveying is, quite mistakenly, considered as closely allied to the idea of large production series of identical or similar parts. The assumption that such an installation can only be profitable in continuous, daily operation often forms the inevitable accompaniment.

It is, however, profitable for any plant to shorten production times, even if, for instance, a series of surface-treatment operations requiring eight hours to perform by " static " methods is completed in five hours by the use of mechanical conveyors, which thus remain idle for three hours each day.

Furthermore, in the case of all production conveyors and particularly the circular conveyors so often used in painting work, the power costs are hardly noticeable in comparison with the other power requirements of the paint shop. The conveyor can thus be allowed to run the whole day, in constant readiness, even if the work to be done by the equipment served is restricted to only part of the working day, and the conveyor therefore appears to be insufficiently or inefficiently utilized. Whether the conveyor runs during the whole working day, or only part of it, its value consists primarily in its ability to link a number of working points and to accelerate the progress of the work itself.

* The original German article on which this contribution is based was published in Fördern und Heben, 7, 1, 1957

It is peculiar, however, that in many present-day plants it is much easier to obtain consent for the procurement of static equipment such as a new scaling bath or a new drying cabinet than the authorization of a similar sum for the acquisition of a conveyor.

In addition to the doubts so often expressed by paintshop managements as to the wisdom of venturing on " innovations ", the fact has to be considered that installations really " fitting " special requirements or equipment for flow production, cannot be ordered by catalogue from stock. Flow production in painting work, even only on a part scale, definitely requires to be " tailored " to order, which implies careful, preliminary planning. Where such indispensable preparatory work has been skimped, it is impossible to expect optimum results.

With regard to the power requirements for exhausters, blowers, drier fans, etc., the performance and size of a flow-production installation require to be adapted not merely to a particular type or programme of production but to a diversity of other factors. This applies both to large plants with a constant output of work-pieces of similar or identical shape and size ; it applies even more particularly to the medium and small plants, in view of the frequent necessity to handle intermittently occurring small series of parts of very different form and size, in the majority of cases also requiring different treatment.

Since any new acquisitions nowadays represent a serious financial burden, the advantages to be anticipated from any installation in the present state of the art must be correctly balanced against the preservation of its investment value, its adaptability to varying production factors and its capacity for expansion.

Expansion or redeployment of production can in the case of " static " installations be fairly easily dealt with by installing more and more spraying booths, and more and more drying cabinets. In the case of a flow-production installation, conditions become very different, when existing capacity has been exhausted and the equipment has not from the outset been designed and arranged with a view to subsequent expansion.

The re-equipment policy required to increase production will differ widely between the " static " installation and the continuous-flow belt, as soon as the latter has been originally planned for more than an " existant " state.

While the introduction of a new equipment item or unit in a " static " plant in all cases requires additional equipment for transportation and piece handling, the extension of a suitably-designed installation for flow production, in particular, requires the lengthening of the existing circular

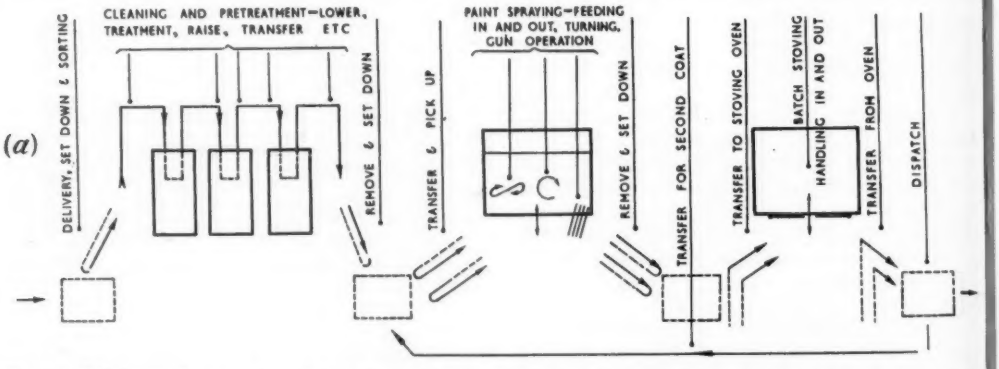
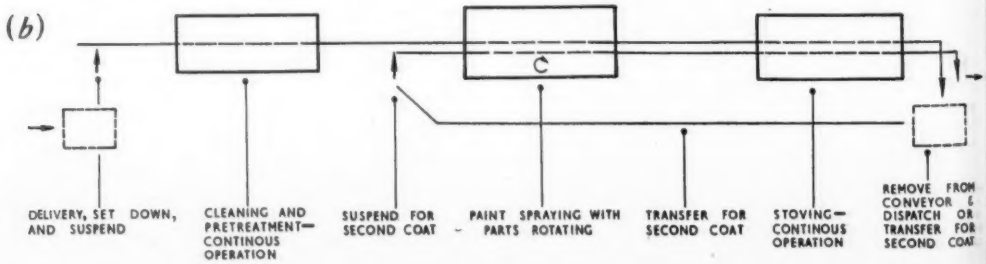


Fig. 1.—Diagrammatic comparison of the amount of handling, transport and labour required in two different spray painting installations. (a) (above) Piecemeal transport of parts on trucks in a system of individual stations (approximately 25 operations are necessary). (b) (below) Mechanical movements of parts on a conveyor in a flow line needing only about five operations.



conveyor, or increasing its speed, or both. This not only affords better utilization of the conveyor equipment, but also a better power economy in ventilation and paint drying.

It must be demanded of any plant extension today, on whatever small scale, that, in addition to improved product quality and hygienic conditions, it shall improve output by simplifying the work sequence and eliminating manual movement of the work ("manhandling"). This does not apply, of course, if only a new spray booth is to be erected, in which only manual handling of the work is possible.

So many factors have to be considered in designing a new flow-production line with circular conveyors that it appears advisable to review these systematically, *e.g.*, in the form of the following questionnaire :

A.—*Scope and Character of the Work Transfer*

1. Can the work be transferred by conveyor, and in what work sequence (cleaning, painting, drying) ?
2. Can all or any of the paint coats be applied by dipping or flooding, or all only by spraying ?
3. Can the work only be conveyed mechanically to the spraying point, or is it possible and desirable to arrange through conveying ?
4. Is "wet on wet" spraying possible, by suitable arrangement of the spraying booths and conveyors ?

B. — *Arrangement of the Work-pieces, and Working Method*

1. What number of work-pieces, or what spraying area can be provided on the conveyor belt, having regard to the necessary spraying time ?
2. Does the shape of the work-pieces allow of complete or partial automatic spraying ?
3. Having regard to the other operations to be performed on the production conveyor, have the work-pieces to be fixed, rotatable or adjustable on the conveyor belt ?
4. Is it possible and advisable to spray the work-pieces while in motion, or have they to be arrested at the spraying point ?
5. What other operations have to be considered in the loading of the work on the conveyor, *e.g.*, chain handling, surface cleaning, paint drying, etc. ?
6. Which conveyor arrangements, suspension and work carriers, afford the best utilization of the conveyor belt, with regard to power-take-off ?

C.—*Type and Layout of Spraying Booths*

1. What type of spraying booth is most suitable in regard to spraying height, exhauster, equipment and arrangement of the work (table, frame or tunnel type) ?
2. If the arrangement of a single spray gun in the

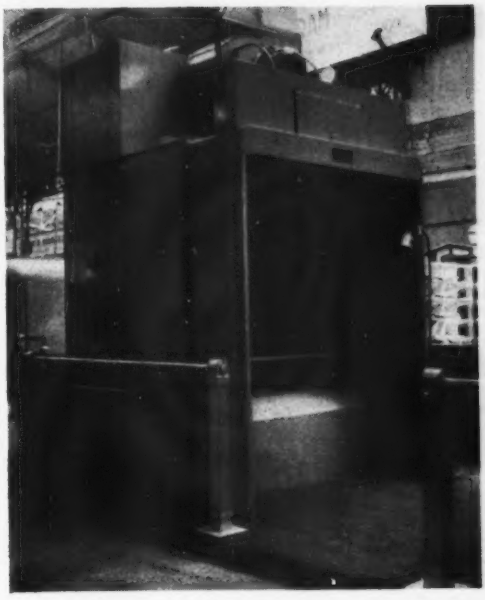


Fig. 2.—(above) A typical spraying station for single articles which does not lend itself to the effective use of flow production principles.

Fig. 3.—(below) Portion of a conveyor track for passing sprayed articles through the drying room.

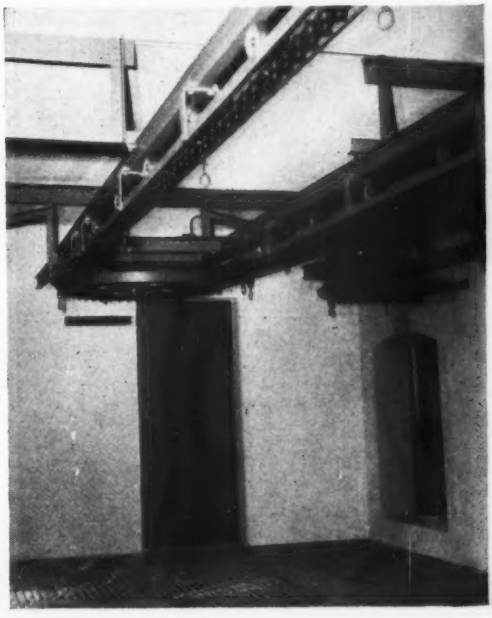
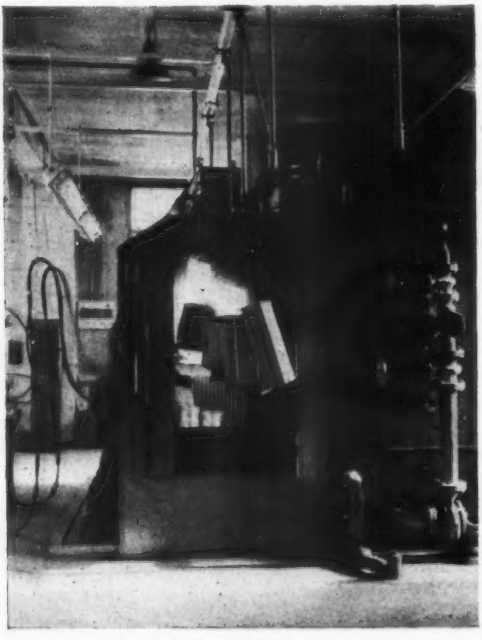


Fig. 4.—(above) Articles being sprayed in a large booth specially designed for the type of conveyor used in conjunction with it.

Fig. 5.—(below) Components of steel office furniture leaving a fully conveyorized paint spraying installation after coating.



working window sufficient or do the arrangement and rate of advance of the work permit the provision of two spraying points ?

3. Must variation in the height of the work-pieces be considered in the design of the working window ?
4. What maximum spraying time or what greatest conveyor band speed require to be considered in determining the spraying distance (travel of the work feed) ?
5. Must the spraying booth be arranged for occasional static spraying of the stationary work-pieces ?
6. Should the colouring of the spraying booth be neutral, adapted to the colour of the work-pieces, or contrast therewith ?

D.—*Construction and Performance of the Spraying Booths*

1. Is the construction of the spraying booth to be such as to admit of substantial variation in the shape of the work-pieces ?
2. What maximum future spraying capacity is to be required of the spraying booth ?
3. Must the installation for this reason have a reserve or margin of output, or be adapted for subsequent expansion ?
4. Do construction and location of the spraying booth enable subsequent modification, for instance, when the conveyor band is lengthened, and is this accompanied by excessive expense ?
5. Is consideration given, in the design and construction of the spraying booth, or by air-blast cleaning, solution recovery and good accessibility, to ease of operation and maintenance.

In designing an installation for high performance and economy, " tailored " planning and construction " to measure " are indispensable. The co-ordination of considerations of painting technique, work hygiene and construction features is a prerequisite for a successful design.

Figs. 2 to 5 show a number of the above features incorporated in new Swiss industrial plants, the production programmes of which include even greater variations in shape and size of the work-pieces than is recognizable from the illustrations.

The results obtained have confirmed that in cases in which the projected adaptability of the installations has given full value to the varying requirements of the case, mechanized work transfer can ensure higher piece rates in production, and equal quality of the product, even if no large series of uniform pieces are to be treated.

The illustrations show installations designed by the present author on the VDB system, for the Albert Stoll furniture factory in Koblenz, Switzerland ; Messrs. Lienhard-Stahlbau, of Erlen, Switzerland ; and S. A. Kremlin, Paris.

The Detection of Micro Quantities of Gelatin

By P. DAVIS

THE profound influence of gelatin and similar lyophilic colloids on the performance of certain plating solutions renders their detection, particularly in trace amounts a matter of some interest. A method of detecting gelatin at very low concentrations was described recently in a communication* from P. Davis to the Journal of Applied Chemistry[1]. The text of this communication is reproduced here with some further comment from the author on the possibility of applying the test to electroplating solutions.

The testing procedure described involves a concentration of the solution by foaming, and detection of the gelatin in the foam by means of a modified Zsigmondy gold sol test. Gelatin can be detected, in the presence of large quantities of electrolyte, at concentrations as low as 4×10^{-8} gm. per ml. The method can be made semi-quantitative and is probably applicable to many other substances.

Introduction

During experiments on the possible presence of gelatin inside the silver halide grains of photographic emulsions[2], the necessity arose for a method for detecting very small amounts of gelatin. This was made particularly difficult by the presence of a large quantity of electrolyte, usually a solution of silver halide in excess thiosulphate. Conventional methods, including the micro-Kjeldhal, biuret, ninhydrin, etc., methods proved either too insensitive or were not applicable in the presence of a high concentration of electrolyte.

A modified Zsigmondy gold sol test was found to be more sensitive, and could be used in the presence of high concentrations of electrolyte. This test is based on the protective-colloid action of gelatin, which prevents a change of colour of the gold sol in the presence of electrolytes. The citrate method of preparation of gold sols[3], was found to give the most reproducible results.

Experimental

The gold sol method for detection of gelatin

Preparation of gold sol.—The technique for the preparation of gold sols is as follows : 1 ml. of a 1 per cent sodium gold chloride solution was added to 100 ml. of boiling distilled water, followed by 8 ml. of 1 per cent potassium citrate solution. The boiling solution first became pale pink or grey (1 minute), then pink and finally a deep wine-red colour. Heating was continued until there was no further increase in depth of colour (15 minutes) and the sol was left for 2-3 days before use.

This ageing of the sol for 2-3 days was very important, as it usually doubled, or, in some cases, trebled, the sensitivity of the sol. No significant increase in sensitivity was observed on ageing the sol for longer than 3 days. All glassware was cleaned before use with aqua regia and with chromic acid, and all chemicals used were of Anala R grade. Even with a standardized method of preparation, slight differences in sensitivity of the sols were observed and all sols had to be tested for sensitivity before use.

The gold sol test.—For the detection of micro quantities of gelatin in the presence of a thiosulphate solution, the following technique was used:

To a test tube containing 20 ml. of the solution, 2 ml. of gold sol was *rapidly* added (e.g., blown in from a syringe pipette) and the tube was immediately shaken. After 2 min., 5 min. and 10 min., the colour of the solution was compared with that of a blank solution containing no gelatin. The colour was viewed through the depth of the solution (approx. 8 cm.) against an opal screen illuminated by a 100-w. bulb. The unchanged sol was red in colour and the changed sol (blank) was pale blue in daylight and nearly colourless in the light of the opal screen.

The criteria used, relating the colour of the sol and presence of gelatin, were as follows :

1. Gelatin present. The sol is a definite red colour, not appreciably different from the original and the colour is stable for at least 10 minutes.
2. Gelatin detectable. The sol gives a reproducible pale pink colour, easily distinguishable from the blank, and stable for at least 5 minutes.
3. No gelatin. The sol is either indistinguishable from the blank or any colour difference is not reproducible or the colour is not stable for 5 minutes.

For solutions of gelatin in water in the absence of electrolytes, a modified test proved much more sensitive, the procedure used being as follows :

To 20 ml. of the gelatin solution, 2 ml. of gold sol were added, followed, after 2 minutes, by 2 ml. of 1M-sodium sulphate solution. The mixture was shaken and the colour observed as in the previous method.

TABLE I

Thiosulphate concentration	Limit of detection gm. per ml.
0.8 M	$50\text{-}75 \times 10^{-8}$
0.6 M	20-30 "
0.4 M	15-25 "
Electrolyte absent using alternative method.	1.5-3.0 "

*Communication No. 1772H from the Kodak Research Laboratories.

In Table I are shown the limits of detection, at various concentrations of thiosulphate, for a "gelatin-present" reaction. The range indicated is that observed over several months, during which time a variety of different gold sols and gelatins were used. These limits all apply to tests on solutions without any previous concentration by foaming.

A "gelatin-detectable" reaction is given with about half the quantity of gelatin required for a "gelatin-present" reaction.

Thus, provided the salt content of the solution is kept below 0.4 M, the test will detect gelatin at a concentration of 25×10^{-8} gm. per ml., and in the absence of electrolyte a ten-fold increase in sensitivity is observed.

Foaming technique for concentration of dilute gelatin solution

These limits of detection, although considerably better than those for the methods previously tried, were still not low enough, and consequently a foaming apparatus for concentration of the dilute gelatin solutions was designed. The apparatus is shown in Fig. 1 and the technique for its use is as follows.

The gelatin solution (100 ml.) is placed in the foaming vessel and the compressed air pressure adjusted to give a satisfactory rate of bubbling, Foam rises up the tube (4 mm. internal diam.), completely filling the first four bulbs, and the liquid produced by degradation of the foam drains down the lower side of the tube (a sloping tube is used in preference to a vertical one to prevent this draining liquid forming a blockage). The rising foam and the descending liquid mix in each of the bulbs, to give a fractionating effect and consequently a higher gelatin concentration in the uppermost bulbs. The foam slowly rises via the last bulb into the collecting chamber, during which process more liquid drains from the foam. The rate of bubbling is controlled so that the concentrate is collected at a rate of approximately 1 ml. per min, between 4 and 5 ml. of concentrate being collected. With amounts of gelatin between 10 and 500μg. in the presence of solutions containing from 10 to 30 per cent sodium thiosulphate and 0 to 10 per cent silver bromide, a twenty-to thirty-fold concentration of the gelatin could be obtained with 80-90 per cent recovery.

In practice, about 20 gm. of the silver bromide, which may contain gelatin, was dissolved in 250 ml. of 20 per cent sodium thiosulphate ($Na_2S_2O_3,5H_2O$). This solution was foamed in three 100-ml. batches, water being added to make up the required volume. The total volume of concentrate collected was between 10 and 15 ml., and after transference of the concentration to a test tube, the volume, with washings, was 20 ml. This resulted in a solution of 0.4M-sodium thiosulphate which was tested for gelatin by the gold sol test as outlined above.

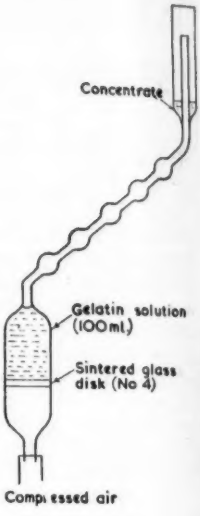


Fig. 1—Foaming apparatus for concentration of dilute gelatin solution

Trial experiments in which 10 μg. of gelatin were added to 20 g. of pure silver bromide, which was then dissolved in 250 ml. of 20 per cent sodium thiosulphate, gave a "gelatin-present" reaction in all cases. The sensitivity of the test is, therefore, 4×10^{-8} gm. per ml. under the conditions used.

In connexion with the possible use of the test for the detection of traces of gelatin and glue in electroplating solutions, two points are worthy of mention :

(a) Neither the foaming technique nor the gold sol test are specific to gelatin. Any surface active compound (e.g. detergents) may interfere with the foaming and any protective colloid can give a positive gold sol test. The gold sol test is, however, much more sensitive towards gelatin than to many other substances. An idea of the relative sensitivities is given in the following table (compiled from Alexander, J., "Glue and Gelatin" American Chemical Society Monograph, Chemical Catalog Co., N.Y. (1923), p. 142).

Substance	Relative amount necessary to give a positive gold sol test
Gelatin	1
Egg Albumen	6
Gum Arabic	35
Sodium Oleate	90
Wheat Starch	500
Dextrin	1,500
Sugar	00

(b) The gold sol test is less sensitive when a very much degraded gelatin is used and the extent to

(*Continued in page* 374)

Production and Applications of ALUMINIUM POWDERS AND PASTES

An Account of Practice at the Louisville Kentucky, works of

REYNOLDS METALS CO.

(*Concluded from page* 322, *August*, 1957)

Aluminium Paint Systems for Wood

THERE are at least three different paint systems for using aluminium paint on wood surfaces :

1. Aluminium paint as a primer, followed by an aluminium paint as a finish coat . . . an all-aluminium system.
2. Aluminium paint as a primer, followed by use of some other type of coating as a finish.
3. Aluminium paint as an admixture with other paints, for use either as a primer, or top coat, or both, or as a one-coat system.

Aluminium Painting Procedure for Metal Surfaces

The correct preparation of any metal surface before applying paint is of extreme importance and the difference between a satisfactory and unsatisfactory job is dependent upon following closely the instructions of the paint manufacturer, both in the preparation of the surface and in the application of the paint.

The following are a few basic principles which if followed should result in a satisfactory application :

1. Clean surface of all grease, dirt, etc.
2. Remove all scale, rust and loose particles.
3. Apply a suitable preparation or primer recommended by the paint manufacturer.
4. Allow surface preparation or primer to dry thoroughly.
5. Use the correct aluminium paint. For outdoor application, usually a long oil varnish type paint is used. For special applications or industrial finishes, etc., consult a reliable manufacturer of these types of finishes.

Aluminium Paint Pigments

Where maximum light and heat reflection is desired, aluminium pigments with coarsest particles between 170 and 325 mesh should be used. The pigment concentration should be the maximum recommended for that type pigment.

Aluminium Paint Vehicles

The satisfactory performance of aluminium paints over rust-inhibitive primers depends largely on the quality of vehicle selected. A good vehicle should have substantial body with a solids content above 50 per cent. and so formulated as to give a tough, elastic film upon drying. Initial drying should take place in about four hours and complete drying within 24 hours.

Application

To produce a paint system assuring maximum life, it is recommended that all seams, welds, joints, rivet and bolt heads should be spot primed and thoroughly dried before applying the complete coat of rust-inhibitive primer. And when applying the complete primer coat, special attention should also be paid to these spots to see that they are properly covered.

On some structures in the shade, it is not unusual to encounter heavy dew deposits. It is recommended therefore, that the painter works with the sun and paints only those surfaces that have been thoroughly dried by the sun. Where structure shades certain parts, these should be dried thoroughly with cloths. The paint should be applied only to clean, dry surfaces as moisture is almost sure to cause trouble.

Aluminium Printing Inks

Because of the bright metallic appearance they produce, aluminium pigments for printing inks have been widely adopted and their use is increasing daily. Formulations have been developed that work well on the different types of presses and papers.

Miscellaneous Coatings

In additions to paints and inks, aluminium powders and pastes are utilized in many other types of coatings. These miscellaneous coatings include those used on roofs, wall paper, gift wrapping paper, ornamental paper, holiday and party decorations and the like.

Roof Coatings

The main advantage of an aluminium surface on top of a roof is that the aluminium reflects about 75 per cent. of the sun's energy, thus making the

roof and space under roof cooler. The overlapping metallic flakes also provide a highly effective shield against the destructive rays of the sun, thus lengthening the life of the roof itself.

Aluminium roof coatings are specially compounded for this purpose. Vehicles for such paints contain volatile solvents for holding the asphalt, or asphaltite, tar or pitch base, which in some instances are compounded with resins, fibres or drying oils. It is possible to make these coatings so thin that the aluminium particles leaf freely to provide a brilliant metallic top surface. Best leafing action is obtained with solvent of high specific gravity.

Aluminium-coated Papers

Paper with an aluminium surface is made by a number of methods. Nearly all work the paper in rolls, by continuous processes. Various effects are obtained dependent upon the pigment, vehicle, and paper stock used.

Aluminium-coated Fabrics

Fabrics for balloons must retain gas, so thin layers of rubber are built in between plies to seal the fabric. But this rubber rapidly deteriorates on exposure to the sun's rays, and the fabric itself also suffers unless protected. The light weight and high reflectivity of aluminium pigments make them specially suitable for protecting both fabric and rubber. As a result, balloon fabric is almost universally shielded by an outer rubber coating pigmented with aluminium.

Dirigibles and other airships also have fabric surfaces coated with aluminium, even though these fabrics need not be gas-tight. Here it helps to preserve the fabric as well as serving another important function—that of minimizing temperature changes by reflecting a large proportion of the sun's heat, thereby providing thermal protection to the gas envelope and conserving valuable helium or other lifting gas.

CHARACTERISTICS OF ALUMINIUM POWDER

Aluminium powder particles have the same properties as the metallic particles in aluminium pastes. The paste differs from the powder only in that a liquid carrier is provided for the aluminium particles.

In paint, the physical characteristics of aluminium powders are utilized. Most all other applications of aluminium powder depend upon the chemical properties of the metal. Its two most important properties in this respect are its strong reducing power (due to its great affinity for oxygen) and the ease with which it replaces metals from other compounds and solutions.

Physical Properties

Shape : Aluminium powder particles are either flake or granular. The flake particles have their width and length dimensions many times their thickness dimensions, so are essentially flat. The granular particles are roughly sausage shaped.

Size : " Watercoverage " tests have been used to determine the thickness of aluminium powder particles. A single pound of a typical Reynolds aluminium powder will cover 11,340 sq. ft. of water. This indicates that the flakes have a thickness of about 0.000005-in. The size of powder particles is determined by the manufacturing methods and the screens through which they are processed.

Size Distribution : If an aluminium powder is passed through a 100-mesh screen, the particles will have a maximum size corresponding to the screen openings. However, there will also be a quantity of smaller particles, the exact proportion depending upon the processing employed in manufacture. Size distribution for a powder is determined by screening ; a sample is screened through a stack of screens, each successive screen having openings of a smaller size.

A typical size distribution for a 150-mesh powder is as follows : Most of the material will pass a 150-mesh screen, a mere trace (less than 0.2 per cent.) being retained on that screen ; about 10.9 per cent. will go through the 150-mesh screen but be retained on the 200-mesh screen ; some 24 per cent. will pass through the 150-mesh and the 200-mesh screen but will be retained on the 325-mesh screen ; approximately 65 per cent. will pass through the 150-, the 200-, and the 325-mesh screen. This large percentage passing through the 325-mesh screen would indicate that a large proportion would pass through a 400-mesh screen.

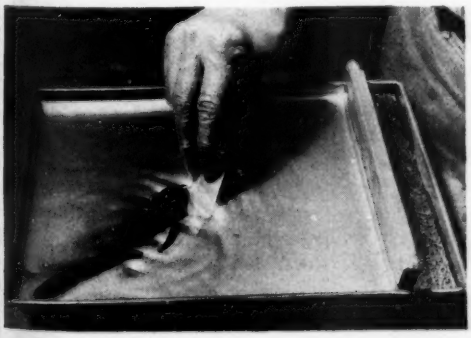
Fig. 10—*Operator running a wet screen particle size analysis on aluminium paste for control of production operations.*

Fig. 11.—Technician performing a pour-out test of aluminium paint in a Reynolds control laboratory.

If particles of a certain size range (such as 150- to 200-mesh) are desired, they are obtained by selecting the powder that passes through the coarser screen (150-mesh) but is retained on the finer (200-mesh) screen.

Colour : The inherent colour of the aluminium particles is determined by the manufacturing sequence. All atomized powder has a dull grey appearance. Flake powder that has been hammered and polished will have a bright silvery colour. The amount of hammering, polishing (if any) as well as amount and kind of lubricant used in hammering affect the colour, appearance and other characteristics of the final product.

Fig. 12.—Water coverage test is made by spreading out measured quantity of powder on water as shown here.



Chemical Properties

Chemical Stability : A properly prepared aluminium powder or paste is chemically stable at ordinary temperatures.

Leafing : Leafing action depends primarily upon the metal particles offering a non-wettable surface to the particular liquid in which they find themselves. The leafing ability of a pigment depends upon the kind and amount of lubricant as well as leafing agent used during manufacture.

Testing and Evaluation

In evaluating an aluminium powder, it is essential to understand fully the relationship between particle size (determined by screening) and particle surface area (determined by a water coverage test). A consideration of the screening action will help to explain this.

In a screen, particles which pass through the openings may be flat, spheroidal, cube shaped, or sausage shaped. A flat particle whose maximum dimension is small enough to pass through the screen openings may actually weigh only a small fraction of that of a spheroidal-shaped particle of same maximum dimension ; the spheroidal particle in turn will weigh less than a cube-shaped particle of same maximum dimension. In the same manner, the screen may pass sausage-shaped particles whose length is much greater than the screen opening dimension but which go through the screen endwise.

It is evident from the above that the terms " mesh fineness " and " particle size ", when applied loosely to aluminium powders and pastes can be extremely misleading. In any case, particle size determinations tell only part of the story. Only when the method of determination is given, and due allowances made when comparing with other methods, can any valuable information be obtained. A powder that is presented as having 3 per cent. retention on a 325-mesh screen may actually be coarser than a powder that shows 5 per cent. retention on the 325-mesh screen, if the first has been worked through the screen more vigorously.

Thus variations in the size of sample used, the length of time sieving action has occurred, the actual diameter of screen openings, the type and condition of mechanical sifting devices, all cause serious differences in results obtained. A mechanical sifter run for many hours on a small sample may show only 1 to 2 per cent. retention. Yet this very same powder run by another recognized screening method may show 16 to 20 per cent. retention on the same screen.

Water Coverage Test : For this test an ordinary cake pan, approximately 8 in. × 14 in. is used.

A baffle plate made from smooth wood is used to control the leafing action. This baffle must be the exact width of the inside of the pan and high enough to permit handling when pan is filled with water. An opening is cut in the bottom of the baffle plate, ½ in. × 4 in., to allow the water in the pan to pass through when tightening the floating powder to the crinkly stage.

To carry out the test the pan is filled with water and the baffle plate placed up against one end. The powder to be tested is lightly dusted over the surface of the water. (Use 1/10 gm. when testing powders of the coarser types ; 1/20 gm. when testing powders of the lining grades and double results to express coverage in square inches per 1/10 gm.).

With a small piece of waxed paper or cellophane, work the powder slowly backwards and forwards over the surface of the water until it is thoroughly spread out. Then move the baffle plate towards the opposite end of the pan until there is approximately ½ in. of crinkle on the coated surface of the floated powder. Measure the surface area completely covered by the aluminium. This will give the number of square inches of coverage per 1/10 gm. of powder (double the result when using 1/20 gm.).

Sag and Colour : After the pigment is thoroughly mixed with the vehicle in the ratio desired, make a pour test by pouring the paint on a clean glass plate and allow to dry in a vertical position. Colour, sag and smoothness then can be compared accurately with a desired standard.

Opacity : Opacity of the mixed paint can be judged against standards by either draw-downs on glass or by the use of standard hiding power charts.

Permanence : Tests for measuring maintenance of colour, etc., under sunlight and weather conditions can be made on racks placed outside in clean areas of the plant yard. Such racks usually hold a number of panels and provide for facing south at an angle of 45 deg.

Accelerated ageing and weathering tests can also be made in a number of special machines developed for that purpose, including the " Weatherometer " which provides a cyclic test, the test specimens being alternately exposed to wetting and drying under varying conditions of light, heat and humidity. This apparatus and the " Radeometer ", which is comparable, duplicate approximately normal ageing conditions. But actual field tests on exposure racks mentioned above or by alternate immersion give results more indicative of weathering conditions encountered in service.

Apparent Density : This is determined by weighing a standard container filled with powder under certain specific conditions that ensure prevention of excessive packing.

Nature of Lubricant : When it may be desirable to determine the nature of the lubricant employed in producing a powder, chemical analysis can be employed.

Reflectivity : The actual percentage of radiant energy reflected by a particular finish can be determined by a reflectometer. These instruments can be adjusted to measure the reflectivity of any particular portion of the spectrum of interest, including the ultra-violet and infra-red portions as well as the visual light wave lengths.

Colour : These are special instruments available for precisely measuring and evaluating different colours and shades. These can be used with metallic aluminium finishes as well as other types of finishes.

Kauri Reduction Test : This test is used to determine the toughness and flexibility of the film produced by any particular vehicle. It is applied primarily to the testing of oleoresinous varnishes. In this test, the elasticity or toughness of the varnish is determined by proportionately reducing its elasticity by the addition of a standard solution of Run Kauri gum in pure spirits of turpentine, or by proportionately increasing the elasticity by adding linseed oil.

A series of test panels so prepared are bent over a standard form to see whether the dried film cracks or not. By bending over a standard form such a series of panels made up with various percentages of reduction, in steps varying by 10 per cent., the limits are determined within 10 per cent. at which a varnish passes one percentage of reduction (film does not crack) and does not pass the next (film cracks). For example, varnishes may be reported at passing at 40 per cent. and breaking at 50 per cent.

Handling and Storing Aluminium Powders and Pastes

Keep Dry : All aluminium powders and pastes should be stored in tightly covered airtight containers. If pastes are exposed to air, the volatile solvents are liberated and the paste dries out. Entrance of air is almost sure to result in undesired reaction due to the moisture content of the air. Likewise it is important to be sure that any containers are thoroughly dried out before placing aluminium powders or pastes in them.

It is desirable to store aluminium powders and pastes at temperatures of 60 to 80° F.

STRESS-FREE NICKEL PLATE

Some Notes on Experience with the Sulphamate Bath in the U.S.A.

by Edward CALDERON*

BY using a nickel sulphamate bath to produce stress-free plating of high tensile strength, the Ryan Aeronautical Company is now able to salvage valuable power-plant components comprising such materials as stainless steel, Inconel-X and alloy A-286.

Nickel coatings conventionally applied in chloride or high-chloride Watts baths would not serve the same purpose because high internal stresses (up to about 60,000 lb. per sq. in.) would cause them to peel, crack, craze, warp, blister, or otherwise become defective and induce either premature fatigue failures or stress corrosion in the metals comprising their deposition surfaces.

Deposits obtained with the sulphamate electrolyte have the smoothness, ductility, and slight sheen of fine-grain, high-purity nickel.

Tensile strength ranges from 60,000 lb. per sq. in., depending upon the conditions under which the bath is operated. Correspondingly, ductility ranges from 30 per cent. elongation in two inches to 6 per cent. elongation at a hardness of 550 VPN. Hardness can be controlled within the range of 200 to 550 VPN with reproducibility by varying the operating conditions.

When depositing nickel under compressive stress, the nickel sulphamate bath exhibits exceptional levelling power. Brush surface analyzer measurements have indicated a 120 microinches RMS to 7 microinches RMS for a plate 5×10^4 in. thickness.

It has been proved that plated coatings containing tensile stress cause premature fatigue failure from stress cracking. Since the majority of fatigue failures originate at the surface, any weakness of a surface condition can be detrimental to metal life under fatigue conditions.

The aircraft industry, in particular, is concerned with effects of plated coatings upon reduction of fatigue strength of steel. Watts or chloride nickel plating baths rendering deposits with high tensile stress, can cause as much as 46 per cent. reduction in the fatigue strength of underlying steel. Nickel deposited compressively by the bath under discussion causes no strength reduction and in some cases improves fatigue strength.

The most important phase of build-up work lies in bringing undersize production parts of worn out tools up to correct size again; for due to the present-day problem of material scarcity, it is necessary to salvage many parts that might be scrapped.

Sulphamic acid, used in the bath, is a white, crystalline, inortanic solid. Because it is non-hygroscopic and non-volatile, it may be safely and conveniently handled and stored. In strength, it

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*Process Engineer, Ryan Aeronautical Co., San Diego, Calif.

The author is here seen (left) operating the nickel sulphamate plating bath in the Ryan laboratory.

A baffle plate made from smooth wood is used to control the leafing action. This baffle must be the exact width of the inside of the pan and high enough to permit handling when pan is filled with water. An opening is cut in the bottom of the baffle plate, ½ in. × 4 in., to allow the water in the pan to pass through when tightening the floating powder to the crinkly stage.

To carry out the test the pan is filled with water and the baffle plate placed up against one end. The powder to be tested is lightly dusted over the surface of the water. (Use 1/10 gm. when testing powders of the coarser types ; 1/20 gm. when testing powders of the lining grades and double results to express coverage in square inches per 1/10 gm.).

With a small piece of waxed paper or cellophane, work the powder slowly backwards and forwards over the surface of the water until it is thoroughly spread out. Then move the baffle plate towards the opposite end of the pan until there is approximately ½ in. of crinkle on the coated surface of the floated powder. Measure the surface area completely covered by the aluminium. This will give the number of square inches of coverage per 1/10 gm. of powder (double the result when using 1/20 gm.).

Sag and Colour : After the pigment is thoroughly mixed with the vehicle in the ratio desired, make a pour test by pouring the paint on a clean glass plate and allow to dry in a vertical position. Colour, sag and smoothness then can be compared accurately with a desired standard.

Opacity : Opacity of the mixed paint can be judged against standards by either draw-downs on glass or by the use of standard hiding power charts.

Permanence : Tests for measuring maintenance of colour, etc., under sunlight and weather conditions can be made on racks placed outside in clean areas of the plant yard. Such racks usually hold a number of panels and provide for facing south at an angle of 45 deg.

Accelerated ageing and weathering tests can also be made in a number of special machines developed for that purpose, including the " Weatherometer " which provides a cyclic test, the test specimens being alternately exposed to wetting and drying under varying conditions of light, heat and humidity. This apparatus and the " Radeometer ", which is comparable, duplicate approximately normal ageing conditions. But actual field tests on exposure racks mentioned above or by alternate immersion give results more indicative of weathering conditions encountered in service.

Apparent Density : This is determined by weighing a standard container filled with powder under certain specific conditions that ensure prevention of excessive packing.

Nature of Lubricant : When it may be desirable to determine the nature of the lubricant employed in producing a powder, chemical analysis can be employed.

Reflectivity : The actual percentage of radiant energy reflected by a particular finish can be determined by a reflectometer. These instruments can be adjusted to measure the reflectivity of any particular portion of the spectrum of interest, including the ultra-violet and infra-red portions as well as the visual light wave lengths.

Colour : These are special instruments available for precisely measuring and evaluating different colours and shades. These can be used with metallic aluminium finishes as well as other types of finishes.

Kauri Reduction Test : This test is used to determine the toughness and flexibility of the film produced by any particular vehicle. It is applied primarily to the testing of oleoresinous varnishes. In this test, the elasticity or toughness of the varnish is determined by proportionately reducing its elasticity by the addition of a standard solution of Run Kauri gum in pure spirits of turpentine, or by proportionately increasing the elasticity by adding linseed oil.

A series of test panels so prepared are bent over a standard form to see whether the dried film cracks or not. By bending over a standard form such a series of panels made up with various percentages of reduction, in steps varying by 10 per cent., the limits are determined within 10 per cent. at which a varnish passes one percentage of reduction (film does not crack) and does not pass the next (film cracks). For example, varnishes may be reported at passing at 40 per cent. and breaking at 50 per cent.

Handling and Storing Aluminium Powders and Pastes

Keep Dry : All aluminium powders and pastes should be stored in tightly covered airtight containers. If pastes are exposed to air, the volatile solvents are liberated and the paste dries out. Entrance of air is almost sure to result in undesired reaction due to the moisture content of the air. Likewise it is important to be sure that any containers are thoroughly dried out before placing aluminium powders or pastes in them.

It is desirable to store aluminium powders and pastes at temperatures of 60 to 80° F.

STRESS-FREE NICKEL PLATE

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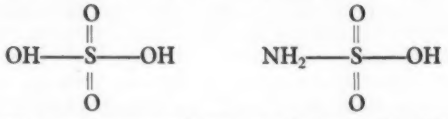
Stress-Free Nickel Plate

(*Continued from page* 373)

is very similar to sulphuric acid, from which it can be chemically distinguished as follows :

SULPHURIC ACID SULPHAMIC ACID



The replacement of one of the hydroxyl (OH) groups of sulphuric acid by the amido (NH_2) group gives to sulphamic acid many of its unique properties which reflect in the superior qualities of electrodeposits obtained from its metal salts in aqueous solution. Sulphamic acid is moderately soluble in water. It produces solutions which are highly acid and compare in *p*H range with those of the three common mineral acids : nitric, sulphuric, and hydrochloric.

The metal salts of sulphamic acid are extremely soluble, and in many instances are the most soluble metal salts known to science. Sulphamic acid is monobasic and will react with metals, oxides, or carbonates to yield the corresponding metal sulphamate by replacement of one hydrogen atom associated with the hydroxyl group.

Nickel sulphamate can be obtained by the reaction of a solution of sulphamic acid with nickel carbonate in accordance with the following equation :

$$Ni\,CO_3 + 2NH_2SO_3H \longrightarrow Ni\,(H_2NSO_3)2 + H_2O + CO_2$$

The nickel sulphamate bath at present being utilized at Ryan is controlled to the following composition and specifications :

Nickel Sulphamate	60 oz. per gal.
Nickel Metal Equivalent	12.2 oz. per gal.
Boric Acid	4 oz. per gal.
Anti-pit Agent (Wetting Agent)	0.05 oz. per gal.
*p*H of Bath	3.0 to 4.5
Temperature	100 to 140°F.
Density	29 to 31° Baume
Agitation	Cathode bar movement, solution circulation or both
Anode efficiency	100 per cent.
Cathode efficiency	98 to 100 per cent.

It is extremely important to measure and control the *p*H of the bath. As the *p*H increases, the compressive stress in the deposit and the hardness increases together with throwing power. Sulphamic acid is used to lower the *p*H, while nickel carbonate raises the *p*H. In addition, the bath temperature must be held to close limits in order consistently to obtain the desired properties of the deposited metal. The hardness of the deposit decreases with increase in temperature within the temperature limits of the bath.

By means of precise controls, the following properties and characteristics are obtained :

(1) Stress-free deposits.
(2) Nickel deposits of high chemical purity.
(3) Improvement to fatigue strength of underlying base metal.
(4) Excellent grain structure and ductility.
(5) High levelling action for easy buffing.
(6) High tensile strength.
(7) Excellent corrosion resistance.
(8) Hard deposits with good ductility.
(9) Heavier, harder, more ductile deposits without build-ups of trees and nodules.
(10) Ductile deposits with controllable compressive and tensile strength.

Detection of Gelatin

(*Continued from page* 368)

which gelatin is degraded by electroplating solutions is probably not known.

Bearing these points in mind, the test may be applicable to electroplating practice, the final decision must, of course, be by trial experiments.

Discussion

This method is applicable to gelatin in the present of other salts, both sodium sulphate and sodium chloride giving the same sensitivity. It is also probably applicable to many other substances which act as protective colloids and show preferential adsorption at the air-water interface during foaming.

The test can be made semi-quantitative by diluting the sample until a " gelatin-detectable " reaction is given rather than a " gelatin-present " reaction and calculating from the known sensitivity of the test.

References

(1) Davis, P., *J. appl. Chem.*, 1956, **6**, pp. 413-415.
(2) Davis, P., " Science and Applications of Photography " (Proc. R. photogr. Soc., Centenary Conference, London 1953), 1955, p. 22 (London : Royal Photographic Society)
(3) Turkevitch, J., Stevenson, P. C., & Hillier, J., *Discuss. Faraday Soc.*, 1951, **11**, 55.

NEW DUTCH JOURNAL

In May of this year a new technical journal devoted to electroplating appeared upon the international scene. Entitled " Galvano Techniek " it is the official organ of the Netherlands plating organization. Among the editors of this new publication is Dr. P. Baeyens, well-known in the U.K. as a contributor and delegate at the Conferences of the Institute of Metal Finishing. Coincident with the appearance of the new Journal has been the cessation of publication of the bulletin published by N.V. Metallic Industry, Loosdrecht, Holland.

FINISHING NEWS REVIEW

INSTITUTE OF VITREOUS ENAMELLERS

Annual Conference to be held in Chester

THE twenty-third annual meeting of the Institute of Vitreous Enamellers will be held at the Grosvenor Hotel, Chester, on October 3 and 4 this year. The programme, which is set out in detail below, includes the formal annual general meeting of the Institute, a whole day visit to the works of John Summers and Sons Ltd. at Shotton, and a number of technical sessions. The proceedings culminate in the annual banquet held at the Grosvenor Hotel, at which guests will be received by the President of the Institute, Mr. C. R. Wheeler and Mrs. Wheeler.

Forms of application for participation in this conference are obtainable from Mr. J. D. Gardom, Secretary, Institute of Vitreous Enamellers, Ripley, Nr. Derby.

Programme

Thursday, October 3

9.00 a.m.—Assemble at Grosvenor Hotel for introductory comments on works visit.

9.30 a.m.—Depart Grosvenor Hotel for full day's visit to works of John Summers and Sons Ltd.
Luncheon will be taken at the Works by invitation of the company.
Members participating in this visit must make use of the official transport provided as arrangements cannot be made to accommodate members employing individual transport.

7 for 7.30 p.m.—Informal dinner Grosvenor Hotel.

Friday, October 4

9.30 a.m.—Annual General Meeting at the Grosvenor Hotel.

10.15 a.m.—*1st Technical Session.* "Continuous Surface Pretreatment Processes at Shotton with particular reference to Nitec Sheet for Vitreous Enamelling" by D. A. Winton and W. H. F. Tickle.

11.30 a.m.—*2nd Technical Session.* "Abrasion Resistance Tests" by J. A. Clarke.

12.30 p.m.—Luncheon.

2.00 p.m.—*3rd Technical Session.* "Architectural Enamelling" by J. Herson.

3.00 p.m.—*4th Technical Session.* "Enamelling of Aluminium" by A. Biddulph.

4.00 p.m.—*5th Technical Session.* "The Application of Vitreous Enamel by the Electrostatic Process" by S. Hallsworth.

7.30 for 8.00 p.m.—Annual Banquet followed by dancing until 1.00 a.m.

Ladies' Programme

In addition to the social functions listed in the main programme above, the following arrangements have been made for the entertainment of ladies during the Conference period.

Thursday, October 3

10.30 a.m.—Depart Grosvenor Hotel for Chirk Castle.

12.45 p.m.—Depart Chirk Castle for Llangollen.

1.15 p.m.—Luncheon at Hand Hotel, Llangollen.

3.00 p.m.—Depart Llangollen and return via Valle Crucis Abbey and Horseshoe Pass, arriving Chester approximately 4.30 p.m.

Friday, October 4

10.30 a.m.—Morning Coffee and Demonstration on Beauty Culture.

12.30 p.m.—Luncheon with delegates.

Afternoon—Free for sightseeing in Chester.

Larger Market for Nickel Wanted

IN a letter to shareholders accompanying the interim report issued recently by The International Nickel Co. of Canada, Dr. John F. Thompson, chairman of the board of directors, said that there were unmistakable signs that the supply and demand position for nickel was tending to equilibrium more rapidly than had been anticipated.

He added that the projected 1961 output would make available for civilian use over 75 per cent more nickel than was obtainable in 1956, assuming that defence demands remained at their present level and that nickel is not taken in 1961 for government stockpiling.

It was up to nickel producers to develop larger markets for the commodity in preparation for the time when the increased capacity and production became available.

BELGIAN BRANCH EXPANDS

THREE years ago George Kent, Ltd., Luton, Beds., decided to establish a branch office in Belgium, with a staff of two people.

Since then the volume of business in the territory has so risen that the staff has had to be increased to eight, and, the office has been converted into a separate company under the title of Kent Continental S.A.

The new company, with headquarters at 82 Chaussée de Charleroi, Brussels, comprises a sales, engineering and service organization covering the full range of Kent products, fully staffed by Kent-trained engineers. There is a well equipped workshop, and a stores that holds a comprehensive stock of spare parts.

The "Poly" Changes its Status

AN open week was held recently at the Northampton College of Advanced Technology in St. John Street, London, to celebrate its change of title and new status from the old "Northampton Polytechnic."

The Worshipful Company of Skinners, one of the ancient livery companies of the City of London, has been connected with the college since its inception in 1894, and appropriately enough, the Master of the Company this year,. Mr. Oliver Thompson, is also chairman of the college's governing body.

A reception, given by the Company at their Hall to inaugurate the open week, was attended by many prominent people concerned with further eduction in this country, including the chairman of the National Council for Technological Awards, Lord Hives.

The following day, Lord Hives announced that his council had approved sandwich courses at the college in applied physics, industrial chemistry, applied mathematics and five branches of engineering, for the Diploma of Technology, and later Sir William Puckey, chairman of the National Council's board of studies, delivered an address entitled "The Challenge of the 'Dip. Tech.'" which was a repeat of a paper first given by Sir Walter at the Institution of Production Engineers' summer conference. After the address, Lord Halsbury, director of the National Research Development Corporation, inaugurated a 'Pegasus' computer which has been installed at the college.

On the third of the open days, Mr. Part, B.A., M.B.E., an Under Secretary at the Ministry of Education, addressed about 150 head-teachers and careers teachers, who were visiting the college's laboratories and workshops, on the way the sandwich courses will affect the secondary schools.

For the remainder of the open week the college was besieged by boys and girls from the upper forms of secondary schools who spent many absorbing hours touring the departments.

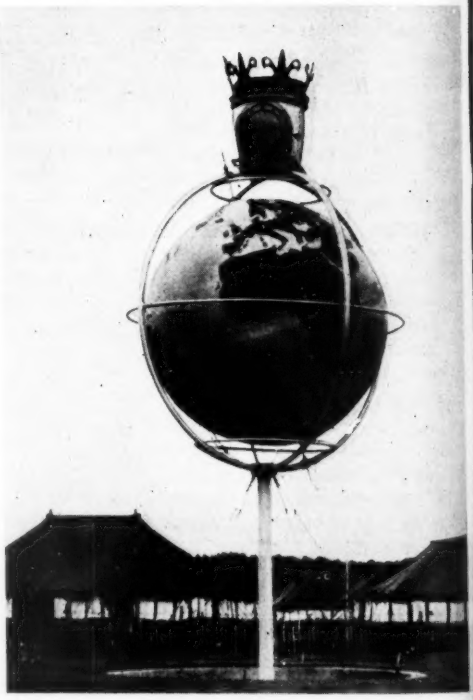
★ *Aluminium Emblem at the Jubilee Jamboree* ★

THE emblem for the Boy Scouts' jubilee jamboree recently held in Sutton Park, Birmingham, was made of treated aluminium except for the globe of the world, which was manufactured in fibre-glass. The Aluminium Development Association, 33 Grosvenor Street, London, W.1. gave advice on the project and supplied all the aluminium required for building the structure.

The surmounting scout motif seen in the picture was made of anodised and dyed aluminium, golden in colour, that on some of the rain-sodden days of the jamboree provided one of the few flashes of colour to be seen at Sutton Park. This treatment of aluminium is becoming increasingly popular for motor car trims.

Both the motif and the globe were able to revolve. The framework was made of tube, sheet and plate, in alloy N4 material. The structure rose to approximately 30 ft. above ground level, and the lower supporting tube of aluminium was sunk into a concrete circular bed.

Mr. Gerald Botteley, T.D., A.M.I.C.E., M.I.Struct.E., designed the structure, and the framework was made by the London Aluminium Co. Ltd. Messrs. Severn-Lamb made the fibre-glass globe and designed the movement for the globe and scout motif.



New Shield for the "Vanguard"

Giant Airframe has a Pre-treatment Process

WHEN the giant 400 m.p.h. Vickers "Vanguard" lifts its bulk into the sky for the first time next year another milestone will have been reached by the men who design and build Britain's aircraft.

The makers, Vickers of Weybridge, decided to scrap the forty-minute process for the pre-treatment of aluminium required by the chromic-anodizing method in favour of a 3-minute dipping procedure using "Alocrom", a product manufactured by Imperial Chemical Industries under licence from the American Chemical Paint Co.

Production of the first Vanguard is well advanced at the Vickers' Weybridge factory and future production is planned at the rate of one per week. Forty Vanguards have been ordered from the drawing board by B.E.A. and T.C.A.

Accommodation is provided for 76 first-class passengers, or 86 mixed (first-class and tourist) or up to 122 passengers in the coach version. The fuselage is of double-bubble configuration which enables a large proportion of the payload of the aircraft (25,000 lb.) to be carried in the freight hold when passenger loads are light.

The Vanguard's stressed skin aluminium alloy fuselage will accommodate five times its own weight of equipment, furnishings and payload.

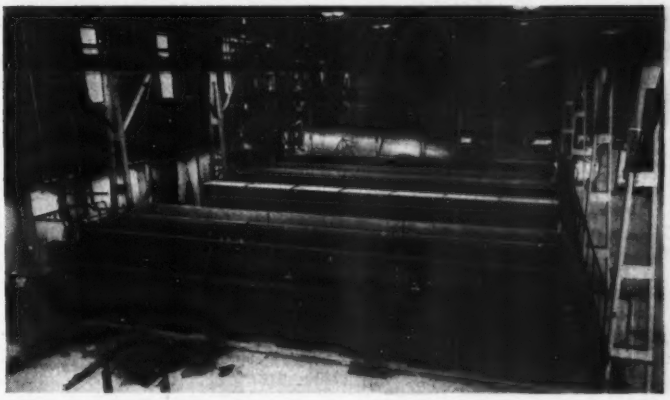
Vickers have just completed the erection at Weybridge of a completely new pre-treatment and painting shop for production of the Vanguard. This includes the biggest "Alocrom" plant in the country, designed to enable Vickers to pre-treat with ease the largest sections of this very large aircraft. The processing tanks in which the parts are dipped are 35 ft. long, 4 ft. wide and 7 ft. deep. Work is fed into the tanks by jigs or baskets on an overhead gantry, the controls for which can be set so that the gantry moves automatically from stage to stage of the process.

The "Alocrom" process forms an oxy-chromate coating on the metal surface that is integral with and as flexible as the metal itself. It does not flake and is stable up to temperatures that are high enough to affect the physical properties of the metal itself.

The provision of a practical and inexpensive method of ensuring paint adhesion on aluminium is of first-rate importance to the aircraft industry. Aluminium does not provide a good key for painting. Pre-treatment processes previously used have included scuffing with abrasive paper, acid etching, alkali treatment and the electrolytic oxidation process known as anodising. But all have fallen short somewhere along the line of simplicity, efficiency and cost.

"Alocrom" has a chemical action upon the metal which produces an excellent painting surface both initally and during the whole life of the paint finish. In addition it provides a safeguard against the start and spread of corrosion should the paint film be damaged.

A view of the tanks in the new pre-treatment processing plant at Vickers Armstrong (Aircraft) Ltd. The tanks measure 35 ft. long by 7 ft. deep and allow large sections of the airframe for the "Vanguard" to be treated.



FINISHING NEWS REVIEW

Praise for the Human Factor in Industry

THE president of the American O. Hommel Co., Mr. E. M. Hommel, was a featured speaker at the July meeting of the American Ceramic Society's southwest section in Mineral Wells, Texas.

Speaking about problems inherent in the manufacture of frits, Mr. Hommel said he thought that more importance should be attached to the human element in the industry, and went on to say that in his opinion, the men who produce the frits were the industry's most important assets. He spoke further of his deep sense of satisfaction at the long years of service given by men who are invaluable in the solution of day-to-day problems encountered in manufacturing.

Mr. Hommel reviewed the highlights in the manufacture of frits and outlined many problems and the possible solutions. He described the machinery and methods used in detecting and eliminating problems and also spoke of the importance of research to a company such as his.

In summary, Mr. Hommel said, "Perhaps I have emphasized a little too much the human element in problem-solving, but one reason for this emphasis is my feeling that equipment, tooling, and testing devices are given a little too much credit in general in the solving of problems such as we have been discussing."

PENSNETT WORKS

ALTHOUGH the Birmingham firm of Horwitch Smith and Co. Ltd. have now concentrated the whole of their paste and polymer division at the Lower Loveday Street works, the Chemical Plant Division continues to operate in the new works at Pensnett, Brierley Hill, Staffs.

NEW OFFICE BLOCK COMPLETED

A NEW seven-storey office block at Wigmore Street, London, W.1. to be known as 3M House, has just been completed for the Minnesota Mining and Manufacturing Co. Ltd.

The imposing building will contain the registered offices of the company, and will house the entire sales and administrative staff of the organisation, including the southern regional sales office, although regional sales offices in Birmingham, Manchester and Glasgow will continue as before.

The 3M Company produce a wide range of products, including coated abrasives, industrial adhesives, pressure-sensitive tapes, magnetic recording tapes, " Scotchlite " reflective sheeting, and " Thermofax " copying and 3M printing products. The telephone number of the new premises is Hunter 5522.

Domestic Equipment Trades Fair

THE first Domestic Equipment Trades Fair will take place at Olympia from August 14 to 23 next year.

The range of domestic equipment to be covered by the fair will include appliances using gas, electricity, solid fuel or oil, for use in lighting, heating, cooking, cleaning, home laundry, refrigeration, ventilation, etc., as well as non-mechanical equipment, and makers of such equipment will be aware of the advantages offered by participation in such a specialized exhibition.

Times have been set aside for the admission of trade representatives only ; the general public will be admitted on most days after 2 p.m. at the turnstiles.

Enquiries and application for space should be made to B. and C. D. Trade Exhibitions Ltd., 194-200, Bishopsgate, London, E.C.2. who are organizing the fair in association with " *The Domestic Equipment Trader*."

Discussion on Degreasing of Metals

AT a South Wales section meeting of the Incorporated Plant Engineers to be held at 7.15 p.m. in the South Wales Engineers' Institute, Park Place, Cardiff, on September 24 a discussion will be held and films will be shown about the process of metal degreasing using trichloroethylene, and of metal pretreatment in industry.

A booklet reviewing the process, issued by Imperial Chemical Industries Ltd., was described briefly in the August issue of this journal.

Electroplating Machines for Italy

THE first of two very large automatic electroplating machines for Fiat S.p.a. of Turino have just been built by the Electro-Chemical Engineering Co. Ltd., Sheerwater, Woking, Surrey. These machines are of the Efco-Udylite return type, specially designed for cleaning, copper, bright nickel and chromium plating bumper bars.

The first machine, for cleaning and copper plating is undergoing a full mechanical test in the firm's new works at Sheerwater which has recently been extended by 10,000 sq. ft. After test the machine will be partially dismantled and shipped to Turin for installation under supervision of the firm's engineers. The second machine, which will be used for cleaning, bright nickelling and chromium plating the bumper bars after they have been copper plated and automatically polished, is now being built.

Automatic Operation

Operation of the machines is fully automatic, transfer operations being carried out hydraulically. The main plating tanks have been designed as extensions of the sections incorporating the transfer mechanisms, thus reducing the structural steelwork and providing greater accessibility. In order to save shipping costs the process tanks are being constructed in Italy to Efco-Udylite designs.

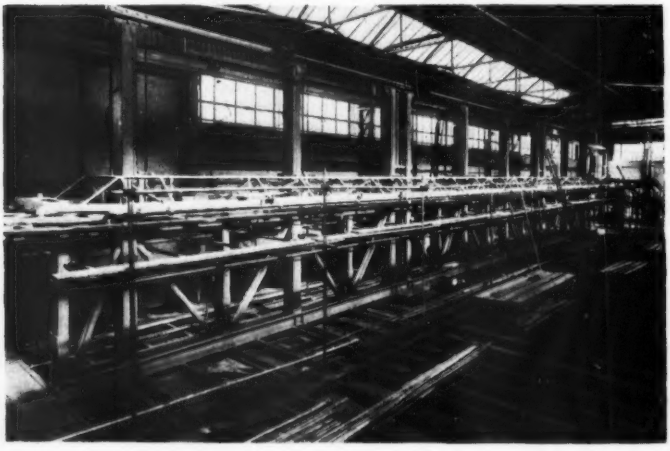
These machines will be among the largest in Europe, being 140 ft. and 160 ft. long respectively, their width 16 ft., and more than 18 ft. high. Process tanks are 6 ft. 6 in. deep and 5 ft. 8 in. wide, the volume of acid copper solution which will be contained being 24,000 gallons, and the volume of bright nickel solution 25,000 gallons.

The installation will process 160 bumper bars per hour, each plating rack holding two bumper bars in a vertical position. Special features include continuous cathode agitation in the nickel tank and the provision of an Efco-Udylite automatic rack-loader and unloader between the shop conveyor and copper plating machine.

Largest in Europe

Since 1950, the firm have supplied seven automatic plating machines to Fiat. On completion of the installation of the new machines at their Mirafiori works Fiat will undoubtedly have the largest and most highly mechanised plating shop in Europe.

An idea of the size of the electroplating machine can be had from this view of one of the tanks under construction



TECHNICAL *and* INDUSTRIAL APPOINTMENTS

Operations of **Monsanto Chemicals Ltd.** are now divided into two, the chemicals division and the plastics division.

Mr. D. R. Mackie has been appointed director of the chemicals division in addition to his duties as managing director. Dr. J. W. Barrett has been appointed director of the plastics division in addition to his duties as technical director.

The directors of the chemicals and plastics divisions will carry overall responsibility in their respective divisions, including the co-ordination of production and engineering, sales, research and personnel. The main products handled by the chemicals division will be heavy and fine chemicals. The main products handled by the plastics division will be plastics, rubber chemicals, oil additives and other technical chemicals.

The following staff changes have also taken place :

Mr. N. F. Patterson, previously operations director, now becomes director of production and engineering with additional overall responsibility for the purchasing department, and, through Mr. S. E. Chaloner, labour relations.

Dr. W. H. Garrett becomes personnel director responsible for industrial relations and general personnel policy.

Mr. W. Morgan Thompson, sales director, has resigned from the company on taking up another appointment.

Mr. D. C. M. Salt has been appointed general manager of sales of the chemicals division and Mr. J. S. Hunter has been appointed general manager of sales of the plastics division.

On the retirement of Mr. F. S. Mortimer, manager of the industrial and public relations department, Mr. A. R. Crew, manager of the advertising department, has now taken over responsibility for public relations also.

The wholly-owned subsidiary, Monsanto Plastics Ltd., will cease to function in view of the change to divisional organisation. Sales of styrene plastics are now the responsibility of the plastics division. Mr. G. V. Cox has been appointed manager, plastics sales department, and will be responsible to Mr. Hunter. Mr. E. L. Pixton has left the company.

* * *

Mr. Adrian Walmsley has been appointed technical representative for the northern area by **Silvercrown Ltd.,** 178/180, Goswell Road, London, E.C.1.

He has a life-long association with the electroplating industry and is this year vice-chairman of the north-west branch of the Institute of Metal Finishing. He has relinquished his

Mr. A. Walmsley

post as manager of the plating department of Burco Ltd., Burnley to join Silvercrown Ltd.

Mr. Walmsley's address is : 36, Lockyer Avenue, Burnley, Lancs. Telephone 5884.

* * *

Mr. D. F. Campfield has been appointed national sales manager, photo records division, of **Remington Rand Ltd.,** Commonwealth House, 1-19 New Oxford Street, London, W.C.1.

He joined the company in 1950 as a sales representative in the systems division, after many years experience in the field of office equipment.

In 1951 he became the first representative in the new photo records department. When the expanding enterprise was made a separate division of the company he became assistant to the national sales manager — the position he held prior to his current appointment.

* * *

Dr. G. Macdougall has been appointed deputy director of research of the **Printing, Packaging & Allied Trades Research Association.** Dr. McDougall has held the position of information officer since 1947. He will continue to be responsible for the Information side of PATRA's activities and will act as director of research when Dr. Harrison is away from the laboratories.

DRIVE AGAINST CORROSION

THE annual bill in the U.K. for metallic corrosion losses is estimated at £600 million yearly, according to one source.

In the British farming industry, for example, the head of a firm of agricultural engineers estimated recently that 8 million tons of steel in the form of farm implements rust away each year.

In a drive to reduce this huge loss to industry, a national anti-corrosion week is being organised from October 14-19. Goods and services designed to combat corrosion will be featured, and technical societies and government departments have been invited to co-operate in the scheme.

On the two days beginning October 15 a convention will be held at Central Hall, Westminster, and starting at the same time a 3-day exhibition, open to the public, will be held in the nearby Old Hall of the Royal Horticultural Society.

Organizers are the *Corrosion Technology* magazine, and application forms for registration for the convention can be obtained from Stratford House, 9 Eden Street, London, N.W.1.

REDUCTION OF ZINC STOCKS

THE Board of Trade announced on December 7, 1956, that they were about to make arrangements for reducing their stocks of zinc, and they have decided to sell about 27,000 tons of zinc in a period of not less than nine months beginning this month. The first sales will be of about 9,000 tons for delivery and pricing over the three months September to November.

The disposal of the remaining 18,000 tons in two or more subsequent three-monthly periods will be announced later.

Of the 27,000 tons, about 9,500 tons will be offered for sale by open competitive tender, and the tender for the three months September to November will be for 3,200 tons.

The remaining 17,500 tons will be offered to the original suppliers or their agents.

NEW COMPANIES

"Ltd" is understood, also "Private Co." Figures = Capital, Names = Directors, all unless otherwise indicated.

Permark Service Ltd., The Common, Cranleigh, Surrey. July 10. £3,000. To take over bus. of marking material carried on at Cranleigh as "Permark Service,' and to carry on bus. of marking by impregnation or otherwise all types of natural or synthetic material; engineers, etc. F. C. Hester and P. H. Hester, A. Stephens and F. W. Burman.

Spray Plants and Equipment Ltd., 10-13 Bedford Street, London, W.C.2. July 17. £100. J. Boas, P. Boas, H. Stebbing.

Getalit Ltd., Harts Lane, Barking, Essex. July 18. £100. To carry on the bus. of importers and exporters of and manufacturers of and dealers in plastics, paper, pulp, cellulose, resins, chemicals, etc. P. W. Palmer, M. Lindner.

Kolene (G.B.) Ltd., July 22. £100. To acquire rights under technical processings disclosed by Kolene Corpn. of Detroit, Michigan, U.S.A., and in particular concession rights in the United Kingdom for supplies to the full field of engineering trades of Kolene Chemical Processes and Equipment.

William Swan (Lappers) Ltd., August 7. £100. To carry on bus. of electro and nickel platers, lappers and finishers, etc. A. J. Round, G. Round, J. W. Round, and L. Tranter.

Stratacolour Ltd., 100, Gosford Street, Coventry, August 9. £1,000. To manufacture and deal in paints, enamels, varnishes, etc. J. Chambers, jnr. and Mrs. M. E. Chambers.

Metallizing (Northern) Ltd., August 9. £1,000. To carry on bus. of metal sprayers, cleaners and finishers, etc. R. W. Stirling, J. Fenton, Rosemary Finn and Anne Gold.

From the Register compiled by Jordan & Sons Ltd. 16, Chancery Lane, London, W.C.2.

TRADE and TECHNICAL PUBLICATIONS

"Cellon Bulletin": The latest issue of this quarterly (Vol. 2, No. 7, July) review of developments in paints and protective finishes for all purposes describes some applications of the firm's products, especially in the aircraft industry.

In passenger carrying aircraft, for example, the parts of the structure not seen by the passenger are those which are most liable to corrosion. As a result of natural condensation, water may remain in contact with the metallic skin for long periods, and there may be contamination from some of the special lubricating oils used in modern jet engines. The company's laboratories have successfully developed corrosion-resistant finishing schemes which also have a very low film weight. The importance of this is illustrated when it is realised that every 1 lb. increase in an aircraft's weight costs the operator, on average in one year, an additional £35.

"International Enamelist": In this issue, Vol. 7, No. 2, of the quarterly journal published for the International Division, Ferro Corporation, 4150 East 56th Street, Cleveland, 5, Ohio, U.S.A., are several articles of lasting interest to the trade.

Mr. Donald R. Goetchius of the Ferro Corporation outlines some new techniques and equipment for the porcelain enamelling industry in a well-illustrated article, and Mr. H. L. Conaway of the U.S. Steel Corporation discusses a method of determining the sag resistance of porcelain enamelling steels. There is also a contribution from three members of the staff of the enamelled metals laboratory of the National Bureau of Standards which is a report of an investigation for the Wright Air Development Centre of the effect of ceramic coatings on the creep of alloys. Other articles deal with corrosion factors in home laundry equipment; materials handling devices in the industry; the theory of electrostatic spraying; the electrostatic application of colour; and the testing for evaluation of resistance to steam condensate attack.

"Finishing Facts": The latest issue of this monthly house journal of the Imperial Chemical Industries Paints Division, Slough, Bucks, carries several articles of interest to metal finishers, and a bibliography on the back cover lists some papers and articles published in recent months on industrial paint finishing.

In a review of the role of colour in design Mr. David Veltman, of the styling division of Vauxhall Motors Ltd., draws from his long experience to tell how colour can support design to give atmosphere and character in car styling. Also of interest is a description of the processes employed at Britains Ltd. in the manufacture and finishing of the familiar toy soldiers of childhood.

In another part of the journal Mr. F. C. Faulkner, of I.C.I., discusses the planning of an efficient paintshop, stressing the importance of having a clear picture of requirements, and a floor plan of a suggested lay-out is included.

"Pretreatment News": This is another of the house journals of the I.C.I. Paints Division, and this issue, No. 10, has some interesting contributions on the use of "Granodine," "Alocrom" and "Deoxidine", all I.C.I. trade names, used in metal pre-treatments. The publicity department of the firm at Wrexham Road, Slough, Bucks, can provide copies free on request.

"Painting Highway Structural Steel": This is the twelfth in the American Lead Industries Associations series of Red Lead Technical Letters which present technical information and paint formulations for the protection of steel for all purposes and conditions.

It presents a number of different complete painting systems for the purpose, including primers, touch-up and field coats for both three and four coat systems. Recommended methods of surface preparation are included, as well as primers with both normal and semi-quick drying times. It also contains suggestions for various coloured finish coats. Among the formulae presented are several which meet the specifications of the American Association of State Highway Officials, and federal specifications. Copies may be obtained free from the Association, 60 East 42nd Street, New York 17, N.Y.

"How to Use the Tac-All Tack Rag": The tack-rag is an indispensable article in the modern finishing shop and has its proper place among the vital points to be considered in the task of ensuring effective control and elimination of dust and fluff. As with most essential articles, there is a right and wrong way to use a tack rag.

This handy instruction sheet prepared by the Tac-All Tack Rag (England) Ltd., 5, St. James's Place, London, S.W.1. describes the correct method of use, and can be had free on request.

Latest Developments in PLANT, PROCESSES AND EQUIPMENT

Air Compressor

A SMALL, portable air-compressor able to produce a continuous pressure up to 50 lb. per sq. in. is now being made by Apparatus and Instrument Co. Ltd., Aico House, Vineyard Path, London, S.W.14. (Fig. 1.)

The "Monoblock Compressor 2½" is electrically driven and has no belts or couplings, so that its servicing is simplified. The electric motor is the capacitor type and its low consumption enables it to be coupled to the mains through a domestic-type supply point.

Used with another of this firm's new products, the "Appinco M.B." spray gun, the compressor forms a portable spray painting unit. Without the gun it can be used for all the conventional work a compressor can do in the garage or workshop.

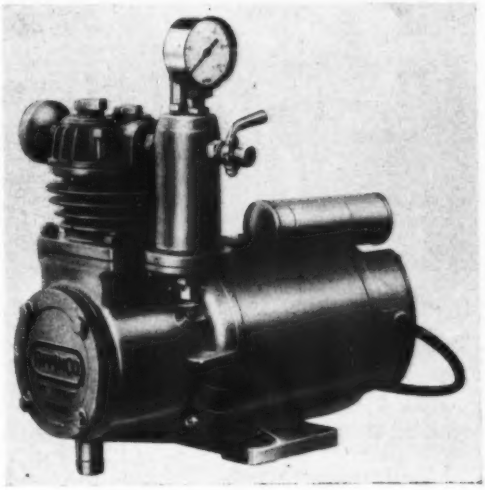


Fig. 1. Portable air compressor

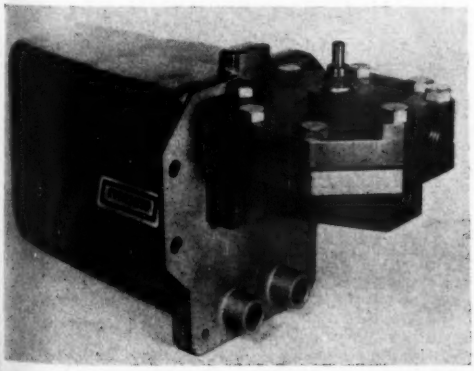
A Differential Pressure Transducer

A DIFFERENTIAL pressure transducer, to convert differential pressures into an electric D.C. signal which is suitable both as a remote indication or as a measured signal for an Evershed electronic process controller, is now being made by Evershed and Vignoles Ltd., Acton Lane Works, Chiswick, London, W.4. (Fig. 2.)

Its construction makes it suitable for measuring oil, fiscous or corrosive fluids as well as water, steam or gases.

Based on this firm's own repeater system, the instrument is unaffected by variations in the mains voltage or frequency, or from changes in the transmission line resistance.

Fig. 2. Differential pressure transducer



The continuously adjustable ranges covered by transmitters type ER.125 are : 0-5 w.g., 0-20 w.g., 0-50 w.g. and 0-200 w.g. Maximum working pressure—1,000 lb. per sq. in. Accuracy—1 per cent. of F.S.D. The output signal can be arranged as either 0-15 mA or 0-30 mA.

Protective Paints

BASED on Neoprene or Hypalon rubber (products of E. I. du Pont de Nemours and Co. Inc.) Semprene-Adcora protective coatings are being marketed in this country by E. and F. Richardson Ltd., Buckingham. (Fig. 3).

The coatings are designed for the protection of items subjected to corrosive conditions of undue severity. Neoprene is a well-established synthetic rubber for which many advantages are claimed over modified natural rubber. It is unsuitable for immersion in some chemicals, and the firm will be glad to advise what these are.

The range covers three types of material : self-curing neoprene coatings in black to give a build slightly above the conventional; accelerated neoprene coatings in black, reinforced and otherwise to give film builds up to 0.020 in. per coat ; and Hypalon

(*Continued in page* 382)

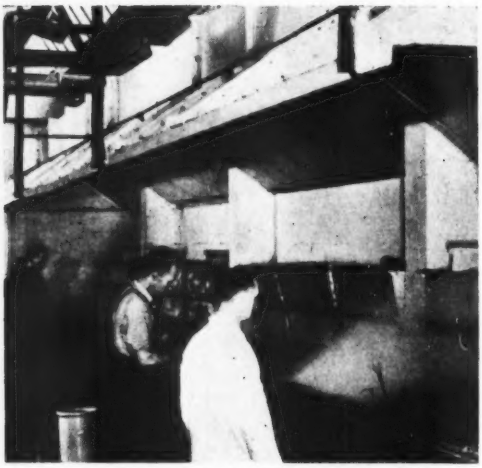


Fig. 3. Ducting painted with a protective finish.

Plant, Processes and Equipment

(*Continued from page* 381)

top coats pigmented with aluminium. It is expected that these finishes will be available in colour before long.

It is claimed that because of the big film builds possible with single coats, significant savings can be achieved in labour, and because the material cost per yard is lower than with similar materials, annual maintenance costs of protection against corrosion can be made cheaper with neoprene finishes.

In one of many simple laboratory tests to illustrate the effectiveness of the finish against different kinds of acids, Semprene-Adcora was brush-applied to a roughly prepared mild steel panel, which was then immersed in a 50 per cent solution of hydro-fluoric acid — used for etching glass. After several weeks' immersion the finish still showed no signs of breakdown.

The new range should be of interest to the chemical and steel industries where corrosion is responsible for large scale wastage.

Infra-red Oven

A NEW Metrovick infra-red oven has been specially designed for the many firms who have to heat-process small articles and materials in batch production. It is suitable for preheating, paint stoving, drying of lacquer, removal of moisture from chemicals and foodstuffs, etc., curing and softening plastics, and the drying and activation of adhesives. (Fig. 4.)

Called the type IRO/2 oven, it is manufactured by Metropolitan-Vickers Electrical Co. Ltd., Trafford Park, Manchester 17, and consists of a sheet steel casing using infra-red tubular sheathed heating elements in trough-shaped anodised aluminium reflectors in the top of the oven which heat the material on a shelf by direct radiation. To conserve any stray radiant heat, the sides and floor of the oven are also lined with aluminium sheet. The exterior finish is in two-tone grey stoved enamel.

Shelf guides are fitted at three heights to suit different applications.

Various items are available at a small extra cost for use with the basic design of oven and these include : asbestos tray, wire mesh tray, hinged front door, floor mounting stand, energy regulator control box.

The asbestos tray is recommended for softening plastic sheets where a heated support is desirable and the wire mesh tray for small metal articles, etc.

For lower intensities of radiant heat and for infinitely variable fine control, a Sunvic energy regulator scaled 0/100 can be provided. This control is arranged for separate mounting, and incorporates a type ERL energy regulator, a 30-amp. special contactor, and red and white indicator lamps, all mounted in a sheet steel box.

The standard IRO/2 oven is rated at 6 kW nominal, and is suitable for use over the voltage range 400/440 V 3-phase or 230/250 V single phase. Outside this range special elements can be supplied. The oven can be equipped with certain variable fixtures to suit specific purposes.

(*Continued in page* 383)

Fig. 4. Infra-red oven

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(*Continued from page* 382)

Corrosion Inhibiting Additive

A FURTHER promotion to the range of filming amines which have now been marketed for the past two years was announced recently by Houseman and Thompson Ltd., D.M. House, Newcastle-upon-Tyne, Co. Durham.

Filming amines are used to prevent corrosion in industrial steam and water cooling systems.

When the water used in process steam systems contains quantities of free or combined carbon dioxide and oxygen in solution, rapid deterioration by corrosion of the equipment occurs, caused by these elements returning to solution in the condensation phase of the steam-water cycle.

Filming amines present in the steam in quantities as small as 1 - 5 p.p.m. will provide a high degree of protection to metals in contact with low pH condense-water by plating out as a thin, impermeable film on the wetted surfaces. The material is easy to handle and is injected into the boiler feed line, the boiler itself or to the steam line. No impedance to heat transfer is offered, and, in fact, this can be increased by as much as 10 per cent because of the removal by the amines of existing fouling and the promotion of droplet condensation.

In cooling systems the quaternary ammonium salts and acetate salts of certain fatty-acid derived amines prevent algae growth and inhibit corrosion.

The filming amines are manufactured in the United Kingdom by Arbour and Co. Ltd., Chemical Division, London, and distributed by Houseman and Thompson Ltd., who are also able to offer a complete advisory service on the uses of amines in industrial steam and water systems. Further technical information is available from the firm on request.

Band Surface Grinder

AMONG the new Greif models recently announced by the English agents, Roland Goodall Ltd., 19 Station Street, Burton-on-Trent, is the G.B.1. band surface grinder for operating on flat surfaces up to 4-in. wide by 1-in. thick (standard capacity).

Powered by a 3-h.p. motor operating at 2,800 r.p.m., the machine incorporates its own conveyor belt to take the production parts. The belt passes under the grinding medium and beyond, where the parts can be taken up again on the flow line.

The standard model has a 2-speed operating belt, but a model with an infinitely variable speed between 6 to 30 ft. per min. can be supplied if required. The conveyor-belt tension and the choice of abrasive band govern the degree of grinding.

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